UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
245 PEACHTREE CENTER AVENUE NE, SUITE 1200
ATLANTA, GEORGIA 30303-1257

July 3, 2014

EN 49969

Mr. Amir Vexler
FMO Facility Manager
Global Nuclear Fuel – Americas, L.L.C.
P.O. Box 780, Mail Code J20
Wilmington, NC 28402

SUBJECT: GLOBAL NUCLEAR FUEL – AMERICAS, L.L.C. – NUCLEAR REGULATORY COMMISSION SPECIAL INSPECTION REPORT NO. 70-1113/2014-006

Dear Mr. Vexler:

The Nuclear Regulatory Commission (NRC) conducted a special inspection from April 14 through April 17, 2014, at the Global Nuclear Fuel – Americas (GNF-A) facility in Wilmington, North Carolina, and a subsequent in-office review of a Root Cause Analysis report and supplementary information. The purpose of the special inspection was to review the facts surrounding the failure to maintain items relied on for safety (IROFS) available and reliable as required by Title 10 of the Code of Federal Regulations (10 CFR) Part 70 (reported as Event Number 49969); assess GNF-A's response to the failure of IROFS; and evaluate the immediate and planned long term corrective actions to prevent recurrence.

In order to accomplish these objectives, a Special Inspection Team (SIT) was chartered (see Enclosure 2) and tasked with developing a timeline of the event and the actions taken by GNF-A; determining the actual and potential safety significance of the event; and assessing the adequacy of GNF-A's: (1) response to the failed IROFS (including immediate actions); (2) establishment of management measures; (3) causal analysis and extent of condition review; and (4) planned long term corrective actions to prevent recurrence. The enclosed report presents the results of the special inspection. At the conclusion of the special inspection, the inspection results were discussed with you and other members of your staff at an exit meeting held via teleconference on May 22, 2014.

The special inspection consisted of interviews with plant personnel, facility walk-downs, selective examinations of relevant procedures and records, review of the Root Cause Analysis report and supplementary information, and plant observations. The enclosed report identified two unresolved items focused on evaluating the significance of licensee's failure to adequately implement management measures for two items relied on for safety that resulted in the failure to meet performance requirements.

In accordance with 10 CFR 2.390 of NRC's "Rules of Practice," a copy of this letter and its enclosures will be made available electronically for public inspection in the NRC Public Document Room, or from the NRC's Agencywide Documents Access and Management System (ADAMS), which is accessible from the NRC Website at http://www.nrc.gov/reading-rm/adams.html. If you have any questions, please call me at (404) 997-4629.

Sincerely,

/RA/

Anthony T. Gody, Director
Division of Fuel Facility Inspection

Docket No. 70-1113
License No. SNM-1097

Enclosures:
1. NRC Inspection Report No. 70-1113/2014-006
   w/Attachment: Supplemental Information
2. GNF-A SIT Charter

cc:
Scott Murray, Manager
Facility Licensing
Global Nuclear Fuels – Americas, L.L.C.
Electronic Mail Distribution

W. Lee Cox, III, Chief
North Carolina Department of Health and Human Services
Division of Health Service Regulation
Radiation Protection Section
Electronic Mail Distribution

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SIGNATURE	JXD2 via e-mail	NAP2 via e-mail	KPK1 via e-mail	PDG2 via e-mail	TJS1 via e-mail	MGC	MDS1
NAME	J. Diaz	N. Pitoniak	K. Kirchbaum	P. Glenn	T. Sippel	M. Crespo	M. Sykes
DATE	6/ 30 /2014	6/ 30 /2014	6/ 30 /2014	6/ 30 /2014	6/ 30 /2014	7/ 2 /2014	7/ 2 /2014
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U.S. NUCLEAR REGULATORY COMMISSION
REGION II

Docket No.:	70-1113
License No.:	SNM-1097
Report No.:	70-1113/2014-006
Licensee:	Global Nuclear Fuel - Americas, LLC
Location:	Wilmington, North Carolina 28402
Dates:	April 14-17, 2014
Inspectors:	J. Díaz-Vélez, Senior Fuel Facility Inspector T. Sippel, Criticality Safety Inspector P. Glenn, Fuel Facility Inspector N. Pitoniak, Fuel Facility Inspector K. Kirchbaum, Fuel Facility Inspector
Approved by:	Anthony T. Gody, Director Division of Fuel Facility Inspector

Enclosure 1

EXECUTIVE SUMMARY

Global Nuclear Fuel - Americas, LLC
NRC Special Inspection Report No. 70-1113/2014-006
April 14-17, 2014

Global Nuclear Fuel – Americas (GNF-A), LLC manufactures uranium dioxide (UO_2) powder, pellets, and light water reactor fuel bundles at its Wilmington, NC facility. The facility converts uranium hexafluoride (UF_6) to uranium oxide (UO_2) using a Dry Conversion Process (DCP) and performs UO_2 gadolinium pellets and fuel fabrication operations.

GNF-A, the licensee, is required by Title 10 of the Code of Federal Regulations Part 70.61 (10 CFR 70.61) to ensure that each engineered or administrative control or control system necessary to comply with paragraphs (b), (c), or (d) of 10 CFR 70.61 be designated as an item relied on for safety (IROFS). The licensee's safety program, established and maintained pursuant to 10 CFR 70.62 shall also ensure that each IROFS be available and reliable to perform its intended function when needed and in the context of the performance requirements of 10 CFR 70.61.

GNF-A periodically performs Recycle Operations in which scrap UO_2 powder is reintroduced into the DCP kiln and reprocessed. The licensee designated IROFS 202-08, the Recycle Dew Point Sensor, and IROFS 202-09, the Recycle Hatch Valve Pressure Indication, as the IROFS to prevent significant moisture accumulation in the vessel that feeds the recycle process. This condition could result in a high consequence event (i.e. unplanned criticality). These IROFS were applicable to DCP Lines 1 and 3. The Recycle Dew Point Sensor is an active engineered control, and the Recycle Hatch Valve Pressure Indication is an augmented administrative control. These controls monitor system parameters and either prevent off normal conditions or alert operators to take action based on off-normal conditions.

The Recycle Dew Point Sensor monitors for moisture in the area upstream of the recycle hatch valves. The Recycle Dew Point Sensor will automatically close the valve on the inlet of the recycle system isolating feed flow and preventing excessive moisture from entering the recycle feed vessel.

The Recycle Hatch Valve Pressure Indication provides indication in the control room of hatch valve performance. This control has an associated alarm that under normal conditions prompts the control room operators when pressure is outside of defined specifications, indicating potential valve degradation. Operators will then assess the condition of the system and take appropriate actions.

On March 28, 2014, after identifying approximately two ounces of water inside a unicone that had been used and removed from DCP Line 3, GNF-A determined that IROFS 202-08, the Recycle Dew Point Sensor, associated with Line 3 of the DCP recycle operations was inoperable because moisture (water) was found blocking the air sampling line. The licensee notified the NRC of the loss of IROFS 202-08 (Event No. 49969), shut down DCP recycling operations, and initiated a review of circumstances.

Upon further review, on March 31, 2014, the licensee determined that IROFS 202-09 also was not available and reliable due to the alarm monitoring function being set to be ignored by the digital control system (DCS). With the alarm function disabled, control room operators would not have been prompted to assess the condition of the system.

The licensee updated the event notification from a 24-hour to a 1-hour report pursuant to the requirements in 10 CFR 70 Appendix A (a)(4), which requires licensees to report when an event or condition such that no IROFS, as documented in the Integrated Safety Analysis (ISA) summary, remain available and reliable, in an accident sequence evaluated in the ISA.

A special inspection team (SIT) was chartered with assessing the facts and circumstances surrounding the reported failure to meet the performance requirements.

Actual and Potential Safety Significance

Based on the actual amount of water discovered in the unicone, the team determined that there was no actual safety significance to the workers, public, or environment. However, the team determined based on the licensee's ISA summary that the likelihood of a potential criticality accident sequence increased from highly unlikely to not unlikely. This change in risk indicates a failure to meet the performance requirements of 10 CFR 70.61.

An Unresolved Item (URI 2014-006-01) was opened to evaluate the safety significance of the licensee's failure to meet the requirements of 10 CFR 70.61.

Evaluation of the Licensee's Response

Upon initial discovery of moisture in the unicone, the Area Manager conservatively halted the DCP recycle process and placed it in a safe configuration while the source of the moisture was investigated. The licensee's review of the conditions resulted in identification of both of the unavailable IROFS. The licensee made the required NRC 24-hour and 1-hour NRC notifications per 10 CFR Part 70 Appendix A, as applicable, in a timely manner. The team determined that the licensee's response to the identification of moisture in the unicone and their immediate corrective actions were comprehensive and adequate.

Evaluation of the Licensee's Establishment of Management Measures for These IROFS

The team determined that the licensee had not effectively established, implemented, and maintained adequate management measures to assure reliability of IROFS as required per 10 CFR 70.62 and License Application Chapter 11, Management Measures, to ensure the performance requirements of 10 CFR 70.61 were maintained. The team identified weaknesses and deficiencies with processes applicable to configuration management.

An Unresolved Item (URI 2014-006-02) was opened to further evaluate the safety significance of the licensee's failure to adequately establish, implement, and maintain management measures.

Evaluation of the licensee's causal analysis and extent of condition

The team reviewed the licensee's radiological control area (RCA) that identified nine causes and contributing factors. The licensee's analysis did not identify program or process causes nor did it evaluate commonality between these causes. Each of these identified root causes could be linked to configuration control and configuration management systems used by the licensee.

Additionally, more clearly defining the components that are required to ensure IROFS availability was an attribute of each of the identified causes. However, based on the planned long term corrective actions recommended in the Root Cause Investigation Report and in the Supplement to the Root Cause Investigation dated June 6, 2014, the team believes that all of the contributing causes are being addressed to prevent recurrence of this event.

Attachment
Key Points of Contact
List of Items Opened, Closed, and Discussed
Inspection Procedures Used
Documents Reviewed

REPORT DETAILS

1. Event Timeline

GNF-A replaced the Dry Conversion Process (DCP) line 3 recycle hatch valves in preparation for recycle operations per Work Order No. 84103 on March 3, 2014. Past experience with these valves indicated that seat leakage could occur after operating these valves following a period of non-use. The leakage was attributed to powder flow causing wear on the valve seats and extended exposure to heat from the DCP reactor. During periods of recycling inactivity, the recycle hatch valves remain closed and are exposed to high temperatures from normal uranium hexafluoride (UF_6) conversion processing activities.

On March 6, 2014, site personnel completed a satisfactory test of the Dew Point Sensor for recycle line 3 per Functional Test Instruction (FTI) 1332-20. The test applies a simulated dew point electronic signal directly to the dew point sensor, which in turn closes the outlet valve from the unicone being processed. This test does not check the sample line flow, but checks the ability of the dew point sensor to close the valve at a predetermined dew point setpoint. GNF-A commenced recycle operations on the DCP line 3 with no anomalies identified.

On March 13, 2014, GNF-A completed recycle operations on DCP line 3. No anomalies were identified throughout this initial recycle campaign period. Normal UF_6 conversion processing operations were commenced on DCP line 3.

On March 26, 2014, GNF-A secured normal UF_6 conversion processing operations on DCP line 3 and commenced recycle operations with unicone LA7284. Although replacing/refurbishing of recycle hatch valves was established as a good practice due to previous operational experience, the recycle hatch valves were not replaced nor refurbished prior to commencing this UO_2 recycling campaign. The team determined that the licensee did not institutionalize the recycle hatch valves replacement/refurbishing practice as a formal procedure or process prior to initiating a UO_2 recycle campaign.

GNF-A continued recycle operations on DCP line 3 and on March 28, 2014, commenced processing of the fourth unicone of this campaign (unicone LA7302). At approximately 0800, a DCP operator discovered approximately two ounces of moisture in unicone U057, which was previously completed and removed from DCP line 3 recycle operations and was about to be used for another purpose. Unicone U057 was the third vessel processed during this recycle campaign and had completed processing approximately seven hours earlier. The operator immediately notified operations supervisors of the condition.

At approximately 0835 on March 28, 2014, the Area Engineer directed the Control Room Operators to isolate the outlet valve for the unicone currently undergoing processing (LA7302) based on the report of moisture from the previously processed unicone. At approximately 0840, the unicone outlet valve was closed.

At approximately 1300, a functional check of the recycle line 3 Dew Point Sensor was conducted and the operator identified that the sample line rotameter (flowmeter) upstream of the dew point sensor was blocked by water. The licensee evaluated this condition as a failure of IROFS 202-08. The licensee's personnel also noted that recycle hatch valve

pressure indication was lower than expected, but greater than DCP reactor pressure. An immediate follow-on investigation and review of computer printouts and trends was commenced.

On March 28, 2014 at 1645, GNF-A completed the required 24 hour NRC notification per 10 CFR Part 70, Appendix A (b)(2) based on failed IROFS 202-08. This was recorded as NRC Event Notification (EN) No. 49969.

GNF-A issued the formal, documented, Stop Work Order for recycle activities on March 28, 2014 at 1803. At this time, recycle operations had been suspended approximately nine hours earlier.

On March 31, 2014, while performing the review of events associated with IROFS 202-08 failure, the Controls Engineer (CE) discovered a digital configuration associated with recycle hatch pressure set to IGNORE "YES." This setting disabled the Operator Attention Request (OAR) alarm function. The OAR alarm was not expected to be disabled for normal operations. An immediate extent of condition of the other line 3 recycle and outlet hatch logic points were identified to be in normal configuration. GNF-A staff began to evaluate the significance of this abnormal condition. At approximately 0900, the CE notified DCP management of the identified abnormal condition and the needs to further evaluate the condition in order to determine its significance.

On the same day, at approximately 1125, the CE confirmed the abnormally configured logic point was associated with the DCP recycle line 3 recycle hatch pressure indication OAR and that the OAR was part of IROFS 202-09. The CE also confirmed that recycle DCP Line 1 DCS set points were in the normal configuration for both recycle and outlet hatch logic points. DCP Line 2 does not have a recycle processing capability.

On March 31, 2014 at 1220, GNF-A completed the required 1-hour NRC notification per 10 CFR Part 70 Appendix A (a)(4) based on the failed dew point sensor IROFS 202-08 and degraded condition of IROFS 202-09.

The licensee completed a root cause investigation on May 2, 2014, and began implementing additional corrective actions. Recycle operations remained shut down while the licensee conducted the investigation.

2. Analysis of the Actual and Potential Safety Significance

a. Scope and Observations

The team reviewed the associated ISA analysis and evaluations to determine whether the licensee used appropriate assumptions and reasonable scenarios to establish limits for the controlled parameters.

The licensee's ISA Summary Section 5.3.5.5, "Reverse Flow in Recycle Feed System," discusses the applicable accident sequence. The licensee identified the initiating event as a reverse steam flow resulting from reduced nitrogen pressure in the recycle system that may allow reverse flow of steam from the DCP reactor into the recycle feed container. Section 6.2.1, "Loss of Control of Moderation," of Criticality Safety Analysis (CSA) 1332.01 states: "In the event the unicone feed container, upper/lower auger feed systems become empty during recycle feed operations AND hatch valve seats are worn, it is credible to

establish reverse flow and allow reactor kiln steam to enter [a full] feed container…" Subsequently, the steam would potentially moderate the dry UO_2 powder in the feed container and cause a criticality.

The licensee assigned the initiating event frequency for the accident sequence as once per year. The ISA Summary lists two IROFS that were established to reduce the risk of a criticality for this sequence. The first is IROFS 202-08, "Recycle Dew Point Sensor," which is an active engineered control that is credited with a failure probability of 1.0×10^{-2}. Its safety function is to alarm and isolate the recycle feed container upon detection of moisture. The second IROFS is IROFS 202-09, "Recycle Hatch Valve Pressure Indication," which is an augmented administrative control that is credited with a failure probability of 1.0×10^{-2}. Its safety function is to provide a visual and audible alarm when Nitrogen (N_2) pressure is not maintained between the hatch valves. The sequence was therefore assigned an overall likelihood of 1.0×10^{-4} per year.

Amount of Moderator

The licensee conducted a brief analysis to determine the worst case moderator leakage. In this analysis, the licensee bounded hatch valve leakage by assuming that the lower hatch valve failed open; while the upper valve was assumed to continue to operate normally. The licensee bounded the low nitrogen pressure, the effect of UO_2 powder filling the pipe, and the recycle feed pipe being smaller than the reactor kiln exhaust by assuming only 25% of the reactor steam would backflow to recycle when the (remaining) hatch valve is open. The recycle steam flow rate was maximized, with steam loss due to the UO_2/steam reaction being ignored. The licensee assumed that the unicone is feeding recycle for 12 hours (the average process run time). The licensee also assumed that all the steam/water that reaches the recycle feed unicone stays in the unicone. The calculation resulted in 19 liters of steam.

The team assessed the licensee's assumption for using the nominal density by reviewing measurements for powder with the same source (i.e. the DCP Reactor). The team found that these measurements were below the nominal density used in the calculations above. CSA 1332.01, Section 6.2.3 also stated that "There is no credible change in a process parameter that in the conversion process that may increase bulk density" beyond the nominal density. Therefore, the team determined that using the nominal density was adequate since no process would increase its density.

The team also considered the fact that the licensee does not have a requirement to empty the unicone within a time limit. When empty, or with very low amounts of material, a criticality is not possible. The feed process and unicone shape would result in some of the moderated UO_2 being poured out of the unicone and into the favorable geometry feed pipe. Based on these considerations, the team concluded that it would take at least one further upset beyond that considered in the licensee's analysis of moderator leakage to result in the potential for a criticality. Either material must remain in the unicone instead of being discharged, such as might be caused by a broken feed screw, or the other hatch valve must also fail open in order to allow much more steam into the unicone.

The licensee considered the probability of a mechanical failure of one of the butterfly valves in the hatch valves. The mean probability, from the Offshore Reliability Data Handbook (OREDA)-92, of a mechanical failure such that the valve fails open is 6.34 per million hours of operation. The licensee assumed that the recycle system was operating for two weeks out of the year to get a failure rate of 2.1×10^{-3} per year. Based on the above, the team

determined that the simultaneous failure of the two butterfly valves that makeup the hatch valve system would be unlikely, especially given that the valve actuators are located outside of the hotbox in a benign environment.

Finally, the team performed a confirmatory calculation using software for nuclear criticality modeling, SCALE 6.1, to determine the minimum amount of water needed to support a criticality in a fully reflected 500 kg sphere of UO_2 at the same nominal density. Rather than using dry powder, the team assumed the powder already contained 1% water. This calculation indicated that a little less than 24 liters (L) of water (not counting water already present) would be needed, which confirmed the licensee's calculation.

Actual condition

Operating Procedure (OP) 1332.00.205 Steps 6.6.F and G required the operator to remove the powder container lid and visually confirm that the powder container is empty. When this check was performed for unicone U057, no condensation was noted. Unicone U057 was later opened and visually inspected three hours later after being placed in a cooler room. This later visual inspection noted the presence of approximately two ounces of water. No moisture was found in any of the other unicones processed before or after U057. These observations were consistent with small amounts of condensed steam that is an expected condition. The ISA Summary Section 5.3.5.5.2.2 states that "A degradation of the valves would allow a small amount of vapor leak by, but would not by itself challenge the moderation control in the feed container… The concern is a trend of leakage during the pressure-hold that is an implication of major valve seal degradation." Therefore, the team concluded that the amount of steam leakage and moderator accumulation was within the expected values and did not challenge the moderator control on the unicone.

The licensee attempted to quantify the rate of leakage actually experienced during this event. They considered that the most likely time for the leakage into the unicone was during the 80-minute run out and approximated the leakage rate as 1 oz/hr. At this rate it would take more than 676 hours (> 20 days) to exceed 20 L, assuming that all the condensate stayed in the unicone. The team determined that during this time a number of conditions apply that make leakage during the 80-minute run out more likely and/or severe than during routine operation: 1) no powder is in the recycle feed piping, opening a larger path for steam; 2) no powder is on the butterfly valves, so they don't seat as well; and 3) the nitrogen flow to the recycle hatch valves is turned off, increasing the probability of backflow. The team considered it reasonable that most of the steam would have entered the unicone during the 80-minute run out, and therefore little to no powder would have been available to moderate.

However, the team determined that IROFS 202-09, "Recycle Hatch Valve Pressure Indication," was failed (i.e. operator action request suppressed such that the operators would not be alerted to the hatch valve loss of pressure) from the start of the campaign on March 26 resulting in a failure to meet the performance requirements. In addition, the team determined that IROFS 202-08, "Recycle Dew Point Sensor," failed just before the campaign was terminated when the moisture sensor line became plugged with water resulting in a loss of all IROFS on the sequence. The team determined that, with the failure of all IROFS associated with the accident sequence, the licensee failed to meet the performance requirement that high consequence events be highly unlikely. The CSA control on Nitrogen pressure remained (i.e.: recycle nitrogen pressure was greater than reactor pressure), and the hatch valves remained effective in preventing safety significant

moderator intrusion. The team concluded that at least one additional upset would have had to occur before significant leakage due to degraded hatch valve seating surfaces would be possible.

Potential condition

Without the operator being alerted to loss of pressure between the Hatch Valves, the valve leakage has the potential to go unnoticed. The failure to alert the control room operators was a failure of the IROFS. Continued recycle operation could result in further degradation of the hatch valves. Eventually, the valves may have degraded enough for steam to back flow during recycle operations and accumulate in the unicone while material was still present. Several barriers are present that could potentially prevent this situation: the pressure check by the floor operators every shift, nitrogen pressure, the replacement of the hatch valves prior to the start of a campaign, the remaining partial effectiveness of the valves, visual operator inspection of emptied unicones, the presence of powder (which will limit steam intrusion), and the short-term gravity draining nature of the feed process.

b. Conclusion

Based on the licensee's ISA, the loss of both IROFS for the accident sequence changed the calculated likelihood from 1.0×10^{-4} events per year (highly unlikely) to one event per year (not unlikely). This change resulted in a failure to meet the performance requirements of 10 CFR 70.61(d) as stated in the licensee's ISA. However, the actual safety significance was low as the initiating conditions for the accident did not occur.

The NRC has opened an Unresolved Item (URI) 2014-006-01 to further analyze the safety significance of the licensee's failure to meet the performance requirements of 10 CFR 70.61, Performance Requirements.

3. Response to the failed IROFS

a. Scope and Observations

Upon initial discovery of moisture in the unicone on March 28, at 0800, the Area Manager promptly directed the unicone outlet valve to be closed and DCP Line 3 to be placed in Hot Standby Mode. At 0840, the isolation valve for the recycle vessel outlet was closed. At this point the licensee was not aware that the associated IROFS were failed; nonetheless, conservative actions removed the line from service and thus the necessity for these IROFS by stopping the operations for which they were required. When it was determined that there was moisture in the sampling line and IROFS 202-08 was failed, DCP Line 3 was already in Hot Shutdown mode. A Stop Work Order was issued to prevent any restart of recycle operations. The required NRC 24-hour report was completed at 1645 on March 28 per 10 CFR Part 70 Appendix A (b)(2).

When investigating lower than expected recycle hatch valve indication pressures, it was noted that IROFS 202-09 was potentially affected. Upon confirmation that the IROFS was not operable the required 1-hour NRC report was reported at 1220 on March 31 per 10 CFR Part 70 Appendix A (a)(4).

b. Conclusion

The inspection team determined that the response to the failed IROFS and the immediate corrective actions taken by the licensee were sufficient to restore safety and compliance with license requirements. The required NRC notifications were made within the required timeframes.

4. Establishment of Management Measures for IROFS

a. Scope and Observations

The team evaluated the measures credited for ensuring the reliability of each IROFS to determine effectiveness. The licensee installed the equipment necessary for recycle operations for DCP Line 3 in 2012. This modification was made based on the DCP Line 1 design that had been installed in 2006, well before it was designated as an IROFS as part of the 2010 ISA Project. Since Line 3 recycle was based on an existing design, it was not thoroughly evaluated against P/P 10-10, "Configuration Management."

IROFS 202-08, Recycle Dew Point Sensor:

The management measures for IROFS 202-08 (an augmented engineered control) included Design Requirements. For the moisture sensor used, the vendor manual recommended the use of stainless steel tubing and the moisture probe located as close to the sample point as possible. It also advises against the use of dead space that could result in moisture entrapment. These considerations were not accounted for in the design of the moisture sensing IROFS, nor were they analyzed or discussed in the installation change package. The actual plant configuration consisted of ¼ inch plastic tubing from the sample point to the moisture sensor, routed via a path through a filter and a Rotameter that contained dead spaces. Also, the mode of force for the air flow relied on the slight negative pressure from the ventilation exhaust to which the outlet flow of the moisture probe is routed. This design allowed for the accumulation of moisture and condensation in the line which ultimately blocked air flow across the moisture probe and rendered it unable to perform its design function.

The GNF-A ISA Summary credited Maintenance as a management measure. The moisture probe is changed with a factory calibrated probe on an annual basis. The FTI, FTI-1332-20, "Conversion Recycle Valve," is used to test that the moisture probe output signal will close the recycle feed container outlet valve when a high moisture condition exists for greater than five minutes. This FTI did not test the availability of sample medium to verify that it is maintained as recommended by the vendor manual for proper moisture indication and output.

IROFS 202-09, Recycle Hatch Valve Pressure Indication:

Procedures and Maintenance were credited as management measures for IROFS 202-09. This Augmented Administrative Control (AAC) has no procedural requirement or test instruction to test the DCS alarm capability of the IROFS. The alarm was designed to prompt the operators to take credited actions per the analyzed accident sequence. In addition, the calibration of the pressure transmitter that provides alarm input to DCS had been removed from the calibration program and had not been verified in proper calibration for an indeterminate amount of time. However, subsequent testing indicated that the transmitter remained within calibration.

Due to having to stop previous recycle operations mid campaign to replace the recycle hatch valves, the licensee began to have the hatch valve seats replaced prior to each campaign. This practice became routine for several years, however, it was never institutionalized as part of the procedure for recycle operations preparations. In addition, when the current campaign was halted for a two week break, no guidance was available or had been developed to determine if the two week hiatus would warrant replacement of the valves.

Configuration Management is also considered a management measure for IROFS 202-09. However, the configuration of the alarm associated with the AAC was either installed or changed without any configuration tracking or control. If this configuration was the result of a change, it was made outside the use of the procedure for Software Maintenance and Change Control (WI-23-003-03), and did not have a Software Modification Plan (SMP). No digital record of the software change was found, and the Tune Log, which is a physical record of each time the DCS is taken out of its normal Operation Mode, had no record of any changes made to the software that disabled the AAC alarm function. The digital log for changes had a limit of 90 days of records. The team noted that no record of the change was present in the digital log; therefore, the team determined that software configuration of IROFS 202-09 was present more than 90 days earlier than the failure of IROFS 202-08.

b. Conclusion

In August 2012, the licensee installed DCP recycle line capability to Line 3 and implemented the dew point sensor, IROFS 202-08. The team determined that the licensee did not adequately evaluate the design requirements of the modification and its effect on safety controls in accordance with P/P 10-10, Configuration Management Program – Nuclear Management Operations. The modification to DCP Line 3 was implemented with additional components beyond those listed in the modification package. The team determined that an inadequate evaluation of the effect of these additional components resulted in their installation without the technical rigor required to ensure the reliability and availability of IROFS 202-08. The team determined that vendor technical manuals for the dew point installation were not adequately utilized and resulted in the undetected accumulation of moisture in the dew point sampling line, ultimately resulting in failure of IROFS 202-08.

The team determined that FTI-1332-20 for IROFS 202-08 only tested that the dew point moisture sensor output signal closes the recycle feed container outlet valve. The FTI did not test the sampling line. Therefore, the team determined that the management measures for the dew point sensor did not ensure the reliability and availability of IROFS 202-08.

Regarding IROFS 202-09, the recycle hatch valve pressure indication OAR, the team determined that the licensee failed to maintain adequate configuration control of the software in order to insure reliability and availability. The licensee did not establish adequate control of the software configuration. Specifically, the Recycle Hatch Pressure “Ignore Condition” was set to “YES” without a completed Software Maintenance and Change Control (WI-23-003-03) form or post installation software verification that ensured proper operation of the IROFS 202-09. This software configuration prevented the recycle hatch valve low pressure OAR from actuating in the DCS and notifying the control room operator that a potentially abnormal condition exists that requires operator evaluation. The team also determined that the licensee failed to adequately establish management measures to test IROFS 202-09 to ensure continued reliability and availability. No FTI was developed to test the OAR notification capability and alert the control room operator of a potentially abnormal condition.

The team determined that the licensee did not effectively establish, implement, and maintain adequate management measures required per 10 CFR 70.62 and License Application Chapter 11 to ensure the performance requirements of 10 CFR Part 70.61 were maintained. The team identified weaknesses and deficiencies with processes applicable to configuration management, including design requirements, document control, design change control, and maintenance.

The NRC has opened URI 2014-006-02 to further evaluate the safety significance of the licensee's failure to adequately establish, implement, and maintain management measures associated with the event.

5. Causal Analysis and Extent of Condition

a. Scope and Observations

The licensee initiated a Root Cause Investigation to review the events leading to the DCP Recycle IROFS failure, which resulted in the NRC EN 49969. The licensee appointed three individuals for the team, including the GE-Hitachi Human Performance Leader and RCA facilitator, the GLE Manager of Environmental Health and Safety/Nuclear Safety, and the GNF-A Bundle Assembly Team Leader. The licensee used TapRooT® as the basic tool for the root cause investigation, and incorporated the Safety Culture Supplement to the Management Oversight and Risk Tree (MORT) to address Nuclear Safety Culture questions. In addition, the licensee performed a barrier Analysis to verify adequacy of the evaluation. The team considered the tools used by the licensee to perform the root cause analysis to be adequate. The team also considered the expertise of the individuals selected to perform the root cause analysis to be adequate. (TapRooT® is a registered trademark of Systems Improvements, Inc.)

The licensee's evaluation identified four root causes and five contributing factors to the DCP Recycle IROFS failure. The table below summarizes licensee findings.

Root Causes:
1- Problem not anticipated in design[1]
2- Control associated with recycle hatch valves pressure indication (Operator Attention Request), its suppression and activation is a non-fault tolerant system[2]
3- Weaknesses in work processes[3] including operating procedures, functional test instructions, software control, procedure adherence, and conduct of pre-job brief
4- Opportunities for improvement[3] in process and behaviors associated with making decisions including decisions on replacement or refurbishing of Line 3 recycle hatch valves and no entry in the licensee's corrective action program of verification comments re: recycle hatch valves pressure indication (IROFS verification)
Contributing Factors:

[1] Applicable to IROFS 202-08 – Dew Point Sensor
[2] Applicable to IROFS 202-09 – Recycle Hatch Valves Pressure Indication
[3] Applicable to both, IROFS 202-08 – Dew Point Sensor and IROFS 202-09 – Recycle Hatch Valves Pressure Indication

1- Lack of a formal preventive maintenance item[2] to replace or refurbish the recycle hatch valves prior to a recycle campaign
2- Lack of trained peers[2] to support the Controls Engineer
3- Decision to not enter verification comments from the recycle hatch valve pressure indication IROFS[2] in the corrective action program
4- Insufficient training[3]
5- Lack of a pre-job brief[3] for infrequently performed tasks

The team reviewed and evaluated the licensee's Root Cause Investigation to determine the adequacy of the causal analysis and the extent of condition.

b. Conclusion

The team determined that the licensee's analysis did not identify program or process causes nor did it evaluate commonality between these causes. Each of the identified root causes could be linked to configuration control and configuration management systems used by the licensee. Additionally, more clearly defining the components that are required to ensure IROFS availability was an attribute of each of the identified causes. However, based on the corrective actions recommended in the Root Cause Investigation Report and in the Supplement to the Root Cause Investigation dated June 6, 2014, the team believes that all of the contributing causes are being addressed to prevent recurrence of this event.

6. Planned Long Term Corrective Actions

a. Scope and Observations

GNF-A has proposed the following long term corrective actions:

(1) Evaluate FTIs for IROFS in accident scenarios in which failure of a single IROFS would result in a failure to meet performance requirements and ensure FTIs are adequately tested for IROFS availability and reliability.

(2) Verify (evaluate and fix as needed) that IROFS and alarms in other digital control systems (Programmable Logic Controllers (PLCs), Fuel Business System (FBS), etc.) have controls ensuring that changes to the condition of IROFS and alarms are reset or otherwise verified prior to resumption of normal operations. The controls can be engineered or administrative in nature. The licensee plans to make changes to these controls as necessary.

(3) Review tacit knowledge to determine if other IROFS-related components rely on best practices rather than formal preventative maintenance requirements to ensure adequate availability and reliability. The licensee plans to formalize any such best practices found in procedures.

(4) Develop and implement a plan to provide trained peers to support the CE.

(5) Verify that operator rounds tasks are included or reflected in applicable qualification cards for areas other than DCP, and execute on the remaining fuels facility training schedule. The establishment of IROFS boundary definitions for DCP and Fabrication should be considered a long term goal.

b. Conclusion

The NRC identified no issues with the long term corrective actions recommended by the root cause investigation. The licensee will track these corrective actions under CR 9986.

7. Exit Meeting

The inspection scope and results were presented to members of the licensee's staff on May 23, 2014. No dissenting comments were received from the licensee. Proprietary information was discussed but not included in the report.

SUPPLEMENTAL INFORMATION

1. List of Persons Contacted

Name	Title
C. Akiri	COO, GNF-A
J. Bass	RCA Team Member
F. Beaty	DCP Area Engineer
R. Crott	NSE Manager
E. Dunn	CSE
M. Elliott	RCA Team Leader
C. Fleming	Sr. Nuclear Regulatory Counsel/Ombuds Leader
M. Grimstead	RCA Team Member
J. Head	GM Regulatory Affairs
A. Hilton	FAB Manager
B. Howell	PP&SS Manager
U. Latham	Sr. Admin Specialist, Licensing
S. Murray	Licensing and Liabilities Manager
P. Ollis	Licensing Engineer
L. Paulson	GLE EHS/Nuclear Safety Manager
J. Reeves	Integrated Safety Analysis Manager
J. Rohner	Criticality Safety Program Manager
E. Saito	EHS Manager
A. Thomas	CSE
K. Walsh	GNF-A Chief Executive Officer

Other licensee employees contacted included engineers, technicians, production staff, and office personnel.

2. List of Items Opened, Closed, and Discussed

Opened	URI 2014-006-01	NRC to further analyze the safety significance of the licensee's failure to meet the performance requirements of 10CFR 70.61, Performance Requirements.
Opened	URI 2014-006-02	NRC to further evaluate the safety significance of the licensee's failure to adequately establish, implement, and maintain management measures.

3. Inspection Procedures Used

IP 88003, Reactive Inspection for Events at Fuel Cycle Facilities Program
IP 88016, Nuclear Criticality Safety Evaluations and Analyses
IP 88020, Operational Safety
IP 88025, Maintenance and Surveillance of Safety Controls
IP 93812, Special Inspection

4. Documents Reviewed

Procedures:

FTI-1332-01, Closing of the Powder Recycle Valve if Low Pressure is Present in the Chute N2 Sealing Network, Rev. (Rev.) 4.1
FTI-1332-16, Conversion Recycling Upper Screw and Recycle Valve, Rev. 4.1
FTI-1332-20, Conversion Recycle Valve, Rev. 0
FTI-1332-22, Closing of Hydrogen and UF6 Supply Valves and Providing Alarm to Control Room Operator if a Hydrogen Leak is Detected in the Conversion Room, Rev. 0
FTI-1333-1a, Prevent Excess Moderation in the Cooling Hopper by Shutting Off UF_6 Feed to Reactor Followed by Hydrolysis and Pyrohydrolysis Steam Shutdown 5 Minutes Later when Moisture Detection Probes Exceed High Limit, Rev. 6
FTI-1333-02, Prevent Excess Moderation in the Cooling Hopper by Maintaining at Least One Closed Block Valve (XV#2915 or XV#2916) Between Kiln Outlet Hopper and Cooling Hoppers, Rev. 6
OP 1080.20, Decon Facility Operations, Rev. 39
OP 2300.00, Work Order Administration, Rev. 8
OP 2301.00, FMO HVAC Maintenance Operation, Rev. 15
OP 1320.00.000, DCP General, Rev. 00
OP 1320.00.100, DCP General – General Information, Rev. 07
OP 1320.00.101, DCP General – MC&A, Rev. 00
OP 1320.00.201, DCP General – Operations. Rev. 04
OP 1320.00.202, DCP General – Abnormal Ops, Alarms, & Emergency Response, Rev. 01
OP 1320.00.203, DCP General – Maintenance, Rev. 02
OP 1320.00.204, DCP General – Power Outage, Rev. 00
OP 1332.00.000, DCP Conversion, Rev. 00
OP 1332.00.100, DCP Conversion – General Information, Rev. 01
OP 1332.00.101, DCP Conversion – MC&A, Rev. 00
OP 1332.00.201, DCP Conversion – Pre-Startup, Rev. 01
OP 1332.00.202, DCP Conversion – Kiln Heat Up, Rev. 00
OP 1332.00.203, DCP Conversion – Steam Startup, Rev. 00
OP 1332.00.204, DCP Conversion – Normal Operations, Rev. 00
OP 1332.00.205, DCP Conversion – Recycle Operations, Rev. 01
OP 1332.00.206, DCP Conversion – Cold Shutdown, Rev. 00
OP 1332.00.207, DCP Conversion – Abnormal Operations, Rev. 00
OP 1332.00.208, DCP Conversion – Alarm Response & Emergency Operations, Rev. 00
OP 1332.00.209, DCP Conversion – Basic Operator Maintenance, Rev. 04
OP 1332.00.300, DCP Conversion – Process Information, Rev. 00
TOP 12991, Running Recycle on Lines 1 and 3, Rev. 0
CP-06-216, Functional Test Instructions, Rev. 0
CP-16-108, Corrective Action Program, Rev. 5.0
CP-23-03, Software Lifecycle Management, Rev. 5.0
CP-27-114, Integrated Safety Analysis, Rev. 2.0
P/P 10-10, Configuration Management Program – Nuclear Manufacturing Operations, Rev. 24.0
WI-16-108-04, Cause Analysis, Rev. 3.0
WI-23-003-03, Software Maintenance and Change Control, Rev. 1.0

Records:
Change Package 2006156, Reroute Pressure Transmitter from Upper Recycle Screw to Interstitial Space Between Recycle Hatch Valves on Line 1
Change Package 2006174, DCP Conversion Reactor – Kiln
CR-12889, Idle FTIs for Line 2 Recycle
CR-8892, Change Line 3 Recycle Hatch Valves
CR-8893, Update Line 3 Conversion to Match Line 1
CR-12020, Update Drawing P04 1332

Drawings:
P00 1332, Conversion (Line 1) P&I Diagram, Rev. 20
P04 1332, Conversion (Line 3) P&I Diagram, Rev. 15

Misc:
Technical Report TR 1332.00, Dry Conversion Process, Rev. 17
NSR/R 15.02.07, Nuclear Safety Requirements for DCP/Recycle, Rev. 11
Condition Report 9986, Moisture in Unicone U057
Criticality Safety Analysis, DCP Conversion Reactor – Kiln, Rev. 13
Criticality Safety Analysis, DCP Moderator Restricted Area, Rev. 10
Criticality Safety Analysis, Uniform and Non-uniform Moderation Limits for UO2 Powder, Rev. 08
QRA-202, DCP – Conversion, Rev. 8
QRA-204, DCP – Powder, Rev. 5
QRA-701. Decon, Rev. 5
Work Order WO84103, Replace and Rework Line 3 Conversion Recycle Valves Prior to Running Cycle
Work Order WO87356, Rebuild Spare Hatch Valve
SPM-14-019, Dry Conversion Process (DCP) Recycle Operation Root Cause Investigation Report, dated May 2, 20914
SPM-14-023, Dry Conversion Process (DCP) Recycle Operation Root Cause Investigation Report Supplement, dated June 6, 2014

April 7, 2014

MEMORANDUM TO: Jose M. Diaz, Team Leader
Global Nuclear Fuel – Americas, L.L.C., Special Inspection

FROM: Victor M. McCree, Regional Administrator ***/RA/ L. Wert for***

SUBJECT: SPECIAL INSPECTION TEAM CHARTER FOR GLOBAL NUCLEAR FUEL-AMERICAS, L.L.C., DOCKET NO. 70-1113 (INSPECTION REPORT NO. 70-1113/2014-006)

This memorandum confirms the establishment of a Special Inspection Team (SIT) at Global Nuclear Fuel – Americas, L.L.C. (GNF-A) to inspect and assess the facts and circumstances surrounding the failure to meet the performance requirements of 10 CFR 70.61 due to the unavailability of item relied on for safety (IROFS) 202-08 and the unreliability of IROFS 202-09. The issue was initially reported to the NRC Operations Center on March 28, 2014, (Event # 49969) as a 24-hour reportable event and subsequently updated to a 1-hour reportable event on March 31, 2014. You are the inspection leader and should report your status directly to me. Timothy Sippel and Noel Pitoniak are assigned as members of the team to assist in completing the objectives of the Charter. Additionally, Patricia Glenn and Kevin Kirchbaum are assigned in a training status. The onsite inspection should begin on April 14, 2014.

Regional Office Instruction No. 0704, "Documenting Management Directive 8.3, NRC Incident Investigation Program, Reactive Team Inspection Decisions in the Division of Fuel Facility Inspection," Revision 3, was used to evaluate the level of Nuclear Regulatory Commission (NRC) response for this operational event. Based on the deterministic criteria, the staff concluded that this issue involved an event or condition such that no IROFS, as documented in the Integrated Safety Analysis (ISA) summary, remain available and reliable, in an evaluated accident sequence with a high consequence (criticality). The NRC determined that the appropriate level of response was to conduct a Special Inspection based on the licensee's questioning attitude that identified the initial issue, conservative decision making in the activities to date, and the immediate corrective actions taken thus far in response to the conditions identified.

The inspection will be performed in accordance with the guidance of Inspection Procedure (IP) 88003 "Reactive Inspection for Events at Fuel Cycle Facilities," IP 88016 "Nuclear Criticality Safety Evaluation and Analysis," IP 88020 "Operational Safety," IP 88025 "Maintenance and Surveillance of Safety Controls," and the applicable provisions of IP 93812 "Special Inspection." The report will be issued within 45 days of the completion of the inspection.

CONTACTS: Marvin D. Sykes, RII/DFFI
404-997-4629

Anthony T. Gody, RII/DFFI
404-997-4700

Enclosure 2

A copy of the Charter is enclosed for your use. The objectives of the inspection are to gather information and make appropriate findings and conclusions in the areas listed in the Charter. These results will be used as a basis for any necessary follow-up. As indicated in the Charter, the foremost objective is to determine the safety implications and adequacy of the licensee's immediate corrective actions for the issues which resulted in the event.

The team should notify Region II management of any potential generic issues identified as a result of this event for discussion with the Office of Nuclear Material Safety and Safeguards. Safety or security concerns identified that are not directly related to the event should be reported to the Region II office for appropriate action.

This Charter may be modified should you develop significant new information that warrants review.

Enclosure: SIT Charter

Special Inspection Team Charter
Global Nuclear Fuel - Americas
Failure of All Items Relied on for Safety in Recycle Operations

Event

On March 28, 2014, at 1:30PM, GNF determined that one of two items relied on for safety (IROFS) associated with Line 3 of the Dry Conversion Process (DCP) recycle operation (specifically IROFS 202-08, the Recycle Dew Point Sensor) was inoperable. The applicable accident sequence initiator is the uncontrolled backflow of steam from the DCP reactor into the unfavorable geometry recycle feed container containing enriched uranium. The high-consequence sequence is prevented through IROFS 202-08 and IROFS 202-09, the Recycle Hatch Valve Pressure Indication. The licensee verified that the valve system of IROFS 202-09 continued to prevent uncontrolled moderation intrusion to the recycle container; however, it alone was not sufficient to meet performance requirements. Subsequently, on March 31, 2014, GNF determined that IROFS 202-09 was "unreliable" (the prompt/alarm for operator action on the IROFS was suppressed in the Distributed Control System) and therefore the issue warranted a 1-hour notification for having no IROFS available and reliable to prevent a criticality. At no point was there an actual unsafe condition (i.e. dry powder was never moderated).

The issue was revealed during an investigation into the source of condensate on the inside of a recently processed recycle container. The investigation was to verify that both of the IROFS for the applicable accident sequence were operable. During trouble shooting of the moisture probe, the operators noted that the moisture probe was not reporting any readings. An evaluation of the sensor noted a blockage on the sensing line that prevented readings. Three days later, GNF determined that the Recycle Hatch Valves Pressure Indication IROFS, which requires operator action to ensure reliability, was not functioning appropriately. The IROFS prevents the uncontrolled entry of steam into the recycle feed container by only opening one of the valves at a time and by the operator shutting down the recycle process upon indication of the continued inability to maintain pressure between the hatch valves when they are both in the closed position. The licensee noted that the nitrogen pressure was lower than the optimum level (but would still function). However, should an indication of leaking occur (i.e. failure to hold pressure), the control panel is designed to prompt/alarm to notify the operators of the condition and trigger them to respond appropriately. This prompt/alarm was found to be suppressed in the Distributed Control System and therefore it is uncertain that the operators would have been aware of the condition in order to take prompt and appropriate action should the condition have been present. Since the alarm function is part of IROFS 202-09, the licensee concluded that the IROFS was "unreliable."

Objectives

The objectives of the inspection are to: 1) review the facts surrounding the failure to maintain the IROFS available and reliable; 2) assess the licensee's response to the failures; and 3) evaluate the licensee's immediate and planned long term corrective actions to prevent recurrence. To accomplish these objectives, the following tasks will be completed:

1. Develop a timeline of the licensee's actions leading up to and following the determination of the failed IROFS.

2. Determine the actual and potential safety significance.

3. Evaluate the adequacy of the licensee's response to the failed IROFS, including immediate corrective actions.

4. Evaluate the adequacy of the licensee's establishment of management measures for these IROFS, including their design, function, maintenance and testing effectiveness.

5. Evaluate the adequacy of the licensee's causal analysis and extent of condition review.

6. Evaluate the adequacy of the licensee's planned long term corrective actions to prevent recurrence.

Documentation

Document the inspection findings and conclusions in an inspection report within 45 days of the completion of the inspection.