

May 17, 2005

Mr. Paul Gunter, Director  
Reactor Watchdog Project  
Nuclear Information and Resource Service  
1424 16<sup>th</sup> Street NW, Suite 404  
Washington, D.C. 20036

Dear Mr. Gunter:

On behalf of the U.S. Nuclear Regulatory Commission (NRC), I am responding to your February 28, 2005, letter to Chairman Diaz and Commissioners McGaffigan, Merrifield, Jaczko, and Lyons regarding followup questions from the February 24, 2005, Commission briefing on nuclear fuel performance. The specific questions you asked are addressed below.

Before addressing your questions, I want to provide some clarifying information. Relating to the comments made by Mr. Jim Malone (Vice President, Nuclear Fuels - Exelon Generation Company), your letter stated that Quad Cities Unit 1 replaced 233 defective assemblies after becoming the industry leader in radiation exposures to its workforce. I want to clarify that Mr. Malone's slides stated that Quad Cities 1 replaced 233 fuel assemblies that were "susceptible" to failure. Of those 233 fuel assemblies, only 2 assemblies were confirmed to have leaking fuel pins. The balance, 231 fuel assemblies, were removed because Quad Cities 1 fuel-leaking trends and industry operating experience suggested that one or more could show signs of leakage if kept in the reactor core until the next refueling outage. Regarding the statement that Quad Cities 1 is the industry leader in radiation exposures to its workforce, Mr. Malone stated that Quad Cities has a very high source term, predominantly due to Cobalt-60 plateout on the primary system piping from various sources of Stellite within the reactor coolant system. In addition, he stated that their experience with fuel defects is that they do not increase dose relative to the existing source term.

You asked whether the same number of fuel cladding defects experienced at Quad Cities 1 (as discussed in the February 24, 2005, Commission briefing) was acceptable or unacceptable under the current NRC oversight process, and if it was acceptable, you asked for an explanation. The NRC's Reactor Oversight Process (ROP) uses the reactor coolant system (RCS) activity performance indicator (PI) to measure fuel cladding integrity. An increase in the RCS activity can be directly correlated to the integrity of the fuel cladding barrier since perforation of the cladding will result in the release of fission products to the RCS. Monitoring RCS activity is important from a risk-informed perspective since a failure of the fuel cladding is by definition a breach of one of the three barriers to fission product release to the public. The green/white and white/yellow PI thresholds are based on 50 percent and 100 percent of the technical specification limits for RCS activity, respectively. Additional NRC attention is warranted to determine the cause of increased RCS activity at 50 percent of the technical specification limit, and individual plant technical specifications require a plant shutdown within a short time after RCS activity exceeds the technical specification limit. The technical

specification RCS activity levels are set to limit the 2-hour dose at the site boundary to a small fraction of the 10 CFR Part 100 limit in the event of a design basis accident. Specifically for Quad Cities 1, the reported RCS activity PI data has remained below the green/white threshold and thus has been acceptable.

You questioned at what point in the Significance Determination Process (SDP) fuel cladding failure results in a RED finding. As mentioned above, the fuel cladding barrier is one of three barriers to prevent the release of fission products. If a finding is related to the fuel cladding barrier and is not related to another barrier (RCS or containment) nor is the finding related to the initiating event or mitigating systems cornerstones, the ROP Phase 1 SDP will generally screen the issue as green (i.e., very low safety significance). If the finding is related to the fuel cladding barrier, and is also related to another degraded barrier (RCS or containment) or affects the initiating event or mitigating systems cornerstones, a more detailed analysis of the situation is required to determine the significance.

You asked why the public should not view Quad Cities being the industry leader for worker radiation exposures in 2002, during the timeframe of the defective fuel, as a significant disconnect in the agency's and industry's portrayal of this issue as an economic issue versus a safety matter. The high source term that resulted in the high collective dose at Quad Cities in 2002 was predominantly due to Cobalt-60 plateout on the primary system piping from various sources of Stellite within the reactor coolant system and not as the result of fuel failures at the plant. In general, collective doses at nuclear plants are attributed to the type and length of plant outages. In 2002, Quad Cities had two power uprate outages and six other outages. To reduce the source term at Quad Cities and thereby reduce the plant collective dose, the licensee has implemented an action plan to reduce exposure.

Lastly, you asked if the RCS activity PI is an effective metric if it has failed to track conditions deemed "unacceptable" by the industry. The NRC regulatory response is based on licensee performance, and our assessment of licensee performance is based on ensuring public health and safety is adequately protected. The RCS activity PI thresholds were established using the RCS activity technical specifications. If the technical specification requirements are met, the NRC believes that adequate protection of the public is maintained. Setting the green/white PI threshold at 50 percent of the limit ensures increased NRC attention prior to the limit being exceeded. In NRC Manual Chapter 0308, "Reactor Oversight Process (ROP) Basis Document," Attachment 1, it is acknowledged that this PI, as well as the other barrier integrity PIs, are fundamentally different from the other ROP PIs in that they are not based on probabilistic risk data or number of occurrences. Further, it was expected that the green/white threshold would rarely be exceeded. The PI program also provides for an additional indicator in the Radiation Safety Cornerstone for occupational exposure, which assures adequate protection of worker health and safety from radiation exposure. Given the expectation that the coolant activity PI would rarely change and the fact that the threshold for the reactor coolant activity PI and the occupational exposure PI will ensure NRC attention prior to any potential public or occupational health and safety concern, the PI for reactor coolant activity is an adequate input to the NRC's assessment process. Each year the NRC staff conducts an ROP self-assessment to identify ways to improve the ROP. The staff has identified the RCS Activity PI as one of the PIs, among others, that could be improved.

The Commission is interested in avoiding fuel cladding defects and/or failure. In fact, in a March 15, 2005, staff requirements memorandum related to the briefing on nuclear fuel performance, the Commission directed the NRC staff to continue to monitor industry efforts to improve fuel reliability and fuel performance trends and report to the Commission if any impediments to success are identified.

If you have further questions, please feel free to contact me.

Sincerely,

***/RA/ R.W. Borchardt For***

J. E. Dyer, Director  
Office of Nuclear Reactor Regulation

cc: David Lochbaum

May 17, 2005

Mr. David Lochbaum  
Senior Nuclear Safety Engineer  
Union of Concerned Scientists  
1707 H Street NW, Suite 600  
Washington, D.C. 20006

Dear Mr. Lochbaum:

On behalf of the U.S. Nuclear Regulatory Commission (NRC), I am responding to your February 28, 2005, letter to Chairman Diaz and Commissioners McGaffigan, Merrifield, Jaczko, and Lyons regarding followup questions from the February 24, 2005, Commission briefing on nuclear fuel performance. The specific questions you asked are addressed below.

Before addressing your questions, I want to provide some clarifying information. Relating to the comments made by Mr. Jim Malone (Vice President, Nuclear Fuels - Exelon Generation Company), your letter stated that Quad Cities Unit 1 replaced 233 defective assemblies after becoming the industry leader in radiation exposures to its workforce. I want to clarify that Mr. Malone's slides stated that Quad Cities 1 replaced 233 fuel assemblies that were "susceptible" to failure. Of those 233 fuel assemblies, only 2 assemblies were confirmed to have leaking fuel pins. The balance, 231 fuel assemblies, were removed because Quad Cities 1 fuel-leaking trends and industry operating experience suggested that one or more could show signs of leakage if kept in the reactor core until the next refueling outage. Regarding the statement that Quad Cities 1 is the industry leader in radiation exposures to its workforce, Mr. Malone stated that Quad Cities has a very high source term, predominantly due to Cobalt-60 plateout on the primary system piping from various sources of Stellite within the reactor coolant system. In addition, he stated that their experience with fuel defects is that they do not increase dose relative to the existing source term.

You asked whether the same number of fuel cladding defects experienced at Quad Cities 1 (as discussed in the February 24, 2005, Commission briefing) was acceptable or unacceptable under the current NRC oversight process, and if it was acceptable, you asked for an explanation. The NRC's Reactor Oversight Process (ROP) uses the reactor coolant system (RCS) activity performance indicator (PI) to measure fuel cladding integrity. An increase in the RCS activity can be directly correlated to the integrity of the fuel cladding barrier since perforation of the cladding will result in the release of fission products to the RCS. Monitoring RCS activity is important from a risk-informed perspective since a failure of the fuel cladding is by definition a breach of one of the three barriers to fission product release to the public. The green/white and white/yellow PI thresholds are based on 50 percent and 100 percent of the technical specification limits for RCS activity, respectively. Additional NRC attention is warranted to determine the cause of increased RCS activity at 50 percent of the technical specification limit, and individual plant technical specifications require a plant shutdown within a short time after RCS activity exceeds the technical specification limit. The technical

specification RCS activity levels are set to limit the 2-hour dose at the site boundary to a small fraction of the 10 CFR Part 100 limit in the event of a design basis accident. Specifically for Quad Cities 1, the reported RCS activity PI data has remained below the green/white threshold and thus has been acceptable.

You questioned at what point in the Significance Determination Process (SDP) fuel cladding failure results in a RED finding. As mentioned above, the fuel cladding barrier is one of three barriers to prevent the release of fission products. If a finding is related to the fuel cladding barrier and is not related to another barrier (RCS or containment) nor is the finding related to the initiating event or mitigating systems cornerstones, the ROP Phase 1 SDP will generally screen the issue as green (i.e., very low safety significance). If the finding is related to the fuel cladding barrier, and is also related to another degraded barrier (RCS or containment) or affects the initiating event or mitigating systems cornerstones, a more detailed analysis of the situation is required to determine the significance.

You asked why the public should not view Quad Cities being the industry leader for worker radiation exposures in 2002, during the timeframe of the defective fuel, as a significant disconnect in the agency's and industry's portrayal of this issue as an economic issue versus a safety matter. The high source term that resulted in the high collective dose at Quad Cities in 2002 was predominantly due to Cobalt-60 plateout on the primary system piping from various sources of Stellite within the reactor coolant system and not as the result of fuel failures at the plant. In general, collective doses at nuclear plants are attributed to the type and length of plant outages. In 2002, Quad Cities had two power uprate outages and six other outages. To reduce the source term at Quad Cities and thereby reduce the plant collective dose, the licensee has implemented an action plan to reduce exposure.

Lastly, you asked if the RCS activity PI is an effective metric if it has failed to track conditions deemed "unacceptable" by the industry. The NRC regulatory response is based on licensee performance, and our assessment of licensee performance is based on ensuring public health and safety is adequately protected. The RCS activity PI thresholds were established using the RCS activity technical specifications. If the technical specification requirements are met, the NRC believes that adequate protection of the public is maintained. Setting the green/white PI threshold at 50 percent of the limit ensures increased NRC attention prior to the limit being exceeded. In NRC Manual Chapter 0308, "Reactor Oversight Process (ROP) Basis Document," Attachment 1, it is acknowledged that this PI, as well as the other barrier integrity PIs, are fundamentally different from the other ROP PIs in that they are not based on probabilistic risk data or number of occurrences. Further, it was expected that the green/white threshold would rarely be exceeded. The PI program also provides for an additional indicator in the Radiation Safety Cornerstone for occupational exposure, which assures adequate protection of worker health and safety from radiation exposure. Given the expectation that the coolant activity PI would rarely change and the fact that the threshold for the reactor coolant activity PI and the occupational exposure PI will ensure NRC attention prior to any potential public or occupational health and safety concern, the PI for reactor coolant activity is an adequate input to the NRC's assessment process. Each year the NRC staff conducts an ROP self-assessment to identify ways to improve the ROP. The staff has identified the RCS Activity PI as one of the PIs, among others, that could be improved.

The Commission is interested in avoiding fuel cladding defects and/or failure. In fact, in a March 15, 2005, staff requirements memorandum related to the briefing on nuclear fuel performance, the Commission directed the NRC staff to continue to monitor industry efforts to improve fuel reliability and fuel performance trends and report to the Commission if any impediments to success are identified.

If you have further questions, please feel free to contact me.

Sincerely,

***/RA/ R.W. Borchardt For***

J. E. Dyer, Director  
Office of Nuclear Reactor Regulation

cc: Paul Gunter

The Commission is interested in avoiding fuel cladding defects and/or failure. In fact, in a March 15, 2005, staff requirements memorandum related to the briefing on nuclear fuel performance, the Commission directed the NRC staff to continue to monitor industry efforts to improve fuel reliability and fuel performance trends and report to the Commission if any impediments to success are identified.

If you have further questions, please feel free to contact me.

Sincerely,

J. E. Dyer, Director  
Office of Nuclear Reactor Regulation

“This correspondence addresses policy issues previously resolved by the Commission, transmits factual information, or restates Commission policy”

**Identical letters sent to both Mr. Gunter and Mr. Lochbaum**

**DISTRIBUTION: G20050150/LTR-05-0103**

PUBLIC	J. Caldwell, R-III
RidsNrrDipm	RidsNrrDipm
RidNrrDipmlipb	J. Shea
RidsNrrWpcMailCtr	F. Akstulewicz
RidsEdoMailCtr	S. Klementowicz
Bill Dean	OPA
L. Reyes	OCA
RidsOgcMailCtr	
RidsNrrOd	

**G20050150/LTR-05-0103**

**PKG. ML050890306**

**Incoming: ML050620272**

**Response Acc.: ML050890281**

**\*Via E-mail**

OFFICE	IIPB	SC:IIPB	SC:RXSB:DIPM*	TL:HPTeam:DIPM*	BC:DIPM	TECH ED
NAME	DWrona	JAndersen	FAkstulewicz	SKlementowicz	SRichards	PKleene
DATE	04/04/05	04/04/05	03/30/05	03/30/05	04/06/05	3/30/05
OFFICE	D:DIPM	D:NRR	EDO	OCM	D:NRR	
NAME	BBoger	JDyer	LReyes (Ellis Merschoff for)		JDyer (Signature) (RBorchardt for)	
DATE	04/07/05	04/11/05	04/15/05	05/13/05	05/17/05	

**OFFICIAL RECORD COPY**