

ArevaEPRDCPEm Resource

From: WILLIFORD Dennis (AREVA) [Dennis.Williford@areva.com]
Sent: Wednesday, August 15, 2012 7:49 AM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (AREVA); DELANO Karen (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA); KOWALSKI David (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 492 (5815), FSAR Ch. 9, Supplement 8
Attachments: RAI 492 Supplement 8 Response US EPR DC.pdf
Importance: High

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the six questions in RAI No. 492 on July 6, 2011. Supplement 1 and Supplement 2 responses to RAI No. 492 were sent on November 11, 2011 and December 16, 2011, respectively, to provide a revised schedule. Supplement 3 response to RAI No. 492 was sent on February 15, 2012 to provide a technically correct and complete response to one question (Question 09.03.04-24). Supplement 4 response to RAI No. 492 was sent on February 24, 2012 to provide a revised schedule. Supplement 5 response to RAI No. 492 was sent on March 30, 2012 to provide technically correct and complete responses to two questions (Questions 09.03.04-22 and 09.03.04-26). Supplement 6 response to RAI No. 492 was sent on April 4, 2012 to provide a technically correct and complete response to one question (Question 09.03.04-25). Supplement 7 response to RAI No. 492 was sent on April 18, 2012 to provide a technically correct and complete response to one question (Question 09.03.04-21).

The attached file, "RAI 492 Supplement 8 Response US EPR DC.pdf" provides a technically correct and complete final response to Question 09.03.04-23.

The following table indicates the respective pages in the response document, "RAI 492 Supplement 8 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 492 — 09.03.04-23	2	4

This concludes the formal AREVA NP response to RAI 492, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.

7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Wednesday, April 18, 2012 2:32 PM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); KOWALSKI David (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 492 (5815), FSAR Ch. 9, Supplement 7
Importance: High

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the six questions in RAI No. 492 on July 6, 2011. Supplement 1 and Supplement 2 responses to RAI No. 492 were sent on November 11, 2011 and December 16, 2011, respectively, to provide a revised schedule. Supplement 3 response to RAI No. 492 was sent on February 15, 2012 to provide a technically correct and complete response to one question (Question 09.03.04-24). Supplement 4 response to RAI No. 492 was sent on February 24, 2012 to provide a revised schedule. Supplement 5 response to RAI No. 492 was sent on March 30, 2012 to provide technically correct and complete responses to two questions (Questions 09.03.04-22 and 09.03.04-26). Supplement 6 response to RAI No. 492 was sent on April 4, 2012 to provide a technically correct and complete response to one question (Question 09.03.04-25).

The attached file, "RAI 492 Supplement 7 Response US EPR DC.pdf" provides a technically correct and complete final response to Question 09.03.04-21.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format, which support the response to RAI 492 Question 09.03.04-21.

The following table indicates the respective pages in the response document, "RAI 492 Supplement 7 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 492 — 09.03.04-21	2	4

The schedule for a final response to the remaining question has not changed and is provided below.

Question #	Response Date
RAI 492 — 09.03.04-23	August 17, 2012

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.

7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
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From: WILLIFORD Dennis (RS/NB)
Sent: Wednesday, April 04, 2012 9:49 AM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); KOWALSKI David (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 492 (5815), FSAR Ch. 9, Supplement 6
Importance: High

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the six questions in RAI No. 492 on July 6, 2011. Supplement 1 and Supplement 2 responses to RAI No. 492 were sent on November 11, 2011 and December 16, 2011, respectively, to provide a revised schedule. Supplement 3 response to RAI No. 492 was sent on February 15, 2012 to provide a technically correct and complete response to one question (Question 09.03.04-24). Supplement 4 response to RAI No. 492 was sent on February 24, 2012 to provide a revised schedule. Supplement 5 response to RAI No. 492 was sent on March 30, 2012 to provide technically correct and complete responses to two questions (Questions 09.03.04-22 and 09.03.04-26).

The attached file, "RAI 492 Supplement 6 Response US EPR DC.pdf," provides a technically correct and complete final response to Question 09.03.04-25.

The following table indicates the respective pages in the response document, "RAI 492 Supplement 6 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 492 — 09.03.04-25	2	3

The schedule for the remaining two questions has not changed and is provided below.

Question #	Response Date
RAI 492 — 09.03.04-21	April 18, 2012
RAI 492 — 09.03.04-23	August 17, 2012

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.

7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Friday, March 30, 2012 9:06 AM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); KOWALSKI David (RS/NB)

Subject: Response to U.S. EPR Design Certification Application RAI No. 492 (5815), FSAR Ch. 9, Supplement 5
Importance: High

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the six questions in RAI No. 492 on July 6, 2011. Supplement 1 and Supplement 2 responses to RAI No. 492 were sent on November 11, 2011 and December 16, 2011, respectively, to provide a revised schedule. Supplement 3 response to RAI No. 492 was sent on February 15, 2012 to provide a technically correct and complete response to one question (Question 09.03.04-24). Supplement 4 response to RAI No. 492 was sent on February 24, 2012 to provide a revised schedule.

The attached file, "RAI 492 Supplement 5 Response US EPR DC.pdf" provides a technically correct and complete final response to Questions 09.03.04-22 and 09.03.04-26.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 492 Questions 09.03.04-22 and 09.03.04-26.

The following table indicates the respective pages in the response document, "RAI 492 Supplement 5 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 492 — 09.03.04-22	2	3
RAI 492 — 09.03.04-26	4	4

The schedule for the remaining three questions has not changed and is provided below.

Question #	Response Date
RAI 492 — 09.03.04-21	April 18, 2012
RAI 492 — 09.03.04-23	August 17, 2012
RAI 492 — 09.03.04-25	April 18, 2012

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.

7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Friday, February 24, 2012 5:00 PM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); KOWALSKI David (RS/NB)

Subject: Response to U.S. EPR Design Certification Application RAI No. 492 (5815), FSAR Ch. 9, Supplement 4
Importance: High

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the 6 questions in RAI No. 492 on July 6, 2011. Supplement 1 and Supplement 2 responses to RAI No. 492 were sent on November 11, 2011 and December 16, 2011, respectively, to provide a revised schedule. Supplement 3 response to RAI No. 492 was sent on February 15, 2012 to provide a technically correct and complete response to one question (Question 09.03.04-24).

The schedule for technically correct and complete responses to Questions 09.03.04-22 and 09.03.04-26 has changed as provided below. The schedule for the other 3 questions has not changed.

Question #	Response Date
RAI 492 — 09.03.04-21	April 18, 2012
RAI 492 — 09.03.04-22	April 18, 2012
RAI 492 — 09.03.04-23	August 17, 2012
RAI 492 — 09.03.04-25	April 18, 2012
RAI 492 — 09.03.04-26	April 18, 2012

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.

7207 IBM Drive, Mail Code CLT 2B

Charlotte, NC 28262

Phone: 704-805-2223

Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)

Sent: Wednesday, February 15, 2012 9:56 PM

To: Getachew.Tesfaye@nrc.gov

Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); KOWALSKI David (RS/NB)

Subject: Response to U.S. EPR Design Certification Application RAI No. 492 (5815), FSAR Ch. 9, Supplement 3

Importance: High

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the six questions in RAI No. 492 on July 6, 2011. Supplement 1 and Supplement 2 responses were sent on November 11, 2011 and December 16, 2011, respectively, to provide a revised schedule.

The attached file, "RAI 492 Supplement 3 Response US EPR DC.pdf" provides a technically correct and complete final response to Question 09.03.04-24. Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to Question 09.03.04-24.

The following table indicates the respective pages in the response document, "RAI 492 Supplement 3 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 492 — 09.03.04-24	2	2

The schedule for technically correct and complete responses to the remaining five questions has changed as provided below.

Question #	Response Date
RAI 492 — 09.03.04-21	April 18, 2012
RAI 492 — 09.03.04-22	March 29, 2012
RAI 492 — 09.03.04-23	August 17, 2012
RAI 492 — 09.03.04-25	April 18, 2012
RAI 492 — 09.03.04-26	March 29, 2012

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.

7207 IBM Drive, Mail Code CLT 2B
 Charlotte, NC 28262
 Phone: 704-805-2223
 Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Friday, December 16, 2011 9:29 AM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); KOWALSKI David (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 492 (5815), FSAR Ch. 9, Supplement 2

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the six questions in RAI No. 492 on July 6, 2011. Supplement 1 response to RAI No. 492 was sent on November 11, 2011 to provide a revised schedule.

The schedule for technically correct and complete responses to the six questions has changed as provided below.

Question #	Response Date
RAI 492 — 09.03.04-21	February 15, 2012
RAI 492 — 09.03.04-22	February 15, 2012
RAI 492 — 09.03.04-23	February 15, 2012

RAI 492 — 09.03.04-24	February 15, 2012
RAI 492 — 09.03.04-25	February 15, 2012
RAI 492 — 09.03.04-26	February 15, 2012

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.

7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: RYAN Tom (RS/NB)
Sent: Friday, November 11, 2011 11:16 AM
To: Tesfaye, Getachew
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); KOWALSKI David (RS/NB); WILLIFORD Dennis (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 492 (5815), FSAR Ch. 9, Supplement 1

Getachew,

AREVA NP Inc. provided a schedule for technically correct and complete responses to the six questions in RAI No. 492 on July 6, 2011.

The schedule for technically correct and complete responses to the six questions has been changed and is provided below.

Question #	Response Date
RAI 492 — 09.03.04-21	December 16, 2011
RAI 492 — 09.03.04-22	December 16, 2011
RAI 492 — 09.03.04-23	December 16, 2011
RAI 492 — 09.03.04-24	December 16, 2011
RAI 492 — 09.03.04-25	December 16, 2011
RAI 492 — 09.03.04-26	December 16, 2011

Sincerely,

Tom Ryan for
Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.

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Charlotte, NC 28262
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Email: Dennis.Williford@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Wednesday, July 06, 2011 5:26 PM
To: 'Tesfaye, Getachew'
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); KOWALSKI David (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 492 (5815), FSAR Ch. 9

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 492 Response US EPR DC," provides a schedule since technically correct and complete responses to the six questions cannot be provided at this time.

The following table indicates the respective pages in the response document, "RAI 492 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 492 — 09.03.04-21	2	2
RAI 492 — 09.03.04-22	3	3
RAI 492 — 09.03.04-23	4	4
RAI 492 — 09.03.04-24	5	5
RAI 492 — 09.03.04-25	6	6
RAI 492 — 09.03.04-26	7	7

The schedule for technically correct and complete responses to these questions is provided below.

Question #	Response Date
RAI 492 — 09.03.04-21	November 11, 2011
RAI 492 — 09.03.04-22	November 11, 2011
RAI 492 — 09.03.04-23	November 11, 2011
RAI 492 — 09.03.04-24	November 11, 2011
RAI 492 — 09.03.04-25	November 11, 2011
RAI 492 — 09.03.04-26	November 11, 2011

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.

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Email: Dennis.Williford@areva.com

From: Tesfaye, Getachew [<mailto:Getachew.Tesfaye@nrc.gov>]
Sent: Friday, June 03, 2011 7:22 PM
To: ZZ-DL-A-USEPR-DL

Cc: Sastre, Eduardo; Terao, David; Hearn, Peter; Clark, Phyllis; Colaccino, Joseph; ArevaEPRDCPEm Resource

Subject: U.S. EPR Design Certification Application RAI No. 492 (5815), FSAR Ch. 9

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on May 21, 2011, and on June 1, 2011, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 3986

Mail Envelope Properties (2FBE1051AEB2E748A0F98DF9EEE5A5D4D7F77E)

Subject: Response to U.S. EPR Design Certification Application RAI No. 492 (5815),
FSAR Ch. 9, Supplement 8
Sent Date: 8/15/2012 7:49:10 AM
Received Date: 8/15/2012 7:49:34 AM
From: WILLIFORD Dennis (AREVA)

Created By: Dennis.Williford@areva.com

Recipients:

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Tracking Status: None
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"ROMINE Judy (AREVA)" <Judy.Romine@areva.com>
Tracking Status: None
"RYAN Tom (AREVA)" <Tom.Ryan@areva.com>
Tracking Status: None
"KOWALSKI David (AREVA)" <David.Kowalski@areva.com>
Tracking Status: None
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MESSAGE	17562	8/15/2012 7:49:34 AM
RAI 492 Supplement 8 Response US EPR DC.pdf		186212

Options

Priority: High
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Response to

Request for Additional Information No. 492(5815), Supplement 8

6/03/2011

U.S. EPR Standard Design Certification

AREVA NP Inc.

Docket No. 52-020

**SRP Section: 09.03.04 - Chemical and Volume Control System (PWR) (Including
Boron Recovery System)**

Application Section: 9.3.4

**QUESTIONS for Component Integrity, Performance, and Testing Branch 2
(ESBWR/ABWR Projects) (CIB2)**

Question 09.03.04-23:

RAI 200, Question 09.03.04-19 Part 3 indicated that the equilibrium concentration of ammonia and its effect on demineralizer performance are to be provided at a future date (later in the design process)

Therefore, the Staff requests the applicant to describe the effect of ammonia build on the RCS demineralizer performance.

Response to Question 09.03.04-23:

Ammonia is normally present in reactor coolant in pressurized water reactors (PWR) as a result of radiolysis reactions with hydrogen and nitrogen. Nitrogen entrained in makeup sources and nitrogen cover gas (volume control tank (VCT) and pressurizer during startup and shutdown evolutions) are the principal nitrogen sources in conventional PWR plants. Another source of ammonia is hydrazine decomposition/radiolysis when hydrazine is used to scavenge oxygen during plant startups. The VCT receives seal leak-off from the reactor coolant pumps and uses a nitrogen cover gas during operation at a pressure of approximately 29 psig for flammability and/or deflagration concerns, which provides another nitrogen source. Based on the German KONVOI plant experience, which has a similar design, the estimated nitrogen in the coolant will be approximately 8-10 ppm (~6-8 cc/kg H₂O).

The ammonia in the coolant is limited by radiolysis reactions, the nitrogen level in the coolant, boron dilution and ion exchange. The pressurizer vapor space is continuously vented, which provides another means to limit nitrogen and ammonia. Ammonia is typically about 1 ppm in PWR reactor coolant, as shown in Figure 09.03.04-23-1, for a plant that measures hydrogen and total gas. The difference between the total gas and hydrogen is attributed mostly to nitrogen, with helium from boron-10 activation in the coolant (re: $^{10}\text{B}(n,\alpha)^7\text{Li}$ and $^{10}\text{B}(n,2\alpha)^3\text{H}$) and trace noble gas comprising the remainder. As shown in Figure 09.03.04-23-1, based on the difference between the total gas and hydrogen concentrations, a typical U.S. PWR has dissolved nitrogen levels similar to or slightly greater than the German KONVOI plants, which use a gas management scheme similar to that used in the U.S. EPR plant.

VVER plants routinely operate with ammonia, potassium hydroxide, and lithium in the reactor coolant with boric acid. Ammonia is added to provide hydrogen by radiolysis, potassium hydroxide is added to create alkaline conditions, and lithium is generated by boron-10 activation. These conditions add complexity to ion exchange behavior. A similar situation exists in U.S. operating PWR plants with only ammonia and lithium in the coolant. With lithium-form cation resin in the purification circuit, ammonia is not quantitatively removed by the lithium-form cation resin. This is the reason that a separate hydrogen ion (H⁺) form ion exchange bed is used to control lithium in the coolant; the hydrogen-form resin also removes ammonia and other monovalent cations such as sodium. This effect is shown by the following ion exchange reaction:



Equation 1

$$\begin{aligned} K_{\text{Li}}^{\text{NH}_4} &\approx \frac{[\text{R} - \text{NH}_4][\text{Li}^+]}{[\text{R} - \text{Li}][\text{NH}_4^+]} \\ &\approx \frac{1.95}{0.85} = 2.29 \end{aligned} \quad \text{Equation 2}$$

The selectivity for an eight percent cross-linked gel resin, where 1.95 is the ammonium ion (NH_4^+) selectivity over hydrogen ion (H^+) and 0.85 is the lithium ion (Li^+) selectivity over hydrogen ion (H^+), indicates that the lithium-form resin removes ammonia. The lithium limit for the U.S. EPR reactor coolant is 4.0 ppm and is coordinated with reactor coolant system (RCS) boron throughout the fuel cycle, being reduced to approximately 0.4 ppm by the end of a cycle. This means that ammonia is more quantitatively retained by the lithium-form resin at the end of a fuel cycle as RCS lithium levels are lower relative to the beginning of a cycle. The net effect is that influent and effluent ammonia levels for a lithium-form ion exchanger are nearly the same, with the ammonium-form resin increasing as the cycle progresses and RCS lithium is reduced.

As shown in Figure 09.03.04-23-1, the expected concentration of nitrogen (6-8 cc/kg) in the U.S. EPR reactor coolant is not expected to result in excessive ammonia levels in the reactor coolant. In addition, the pH calculation programs available to U.S. utilities, such as the EPRI Primary pH Calculator, include ammonia in the pH calculation, allowing coolant pH to be accurately predicted and controlled in the presence of ammonia. Since lithium is routinely measured and carefully controlled within prescribed limits in the reactor coolant, ammonia at the several-ppm level will not present undue challenges to RCS lithium control for the U.S. EPR plant. This conclusion is verified by Figure 09.03.04-23-2, which shows that lithium was easily controlled with 7.05 ppm ammonia in the coolant during a mid-cycle outage.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Figure 09.03.04-23-1–Ammonia, Hydrogen and Total Gas in PWR Reactor Coolant

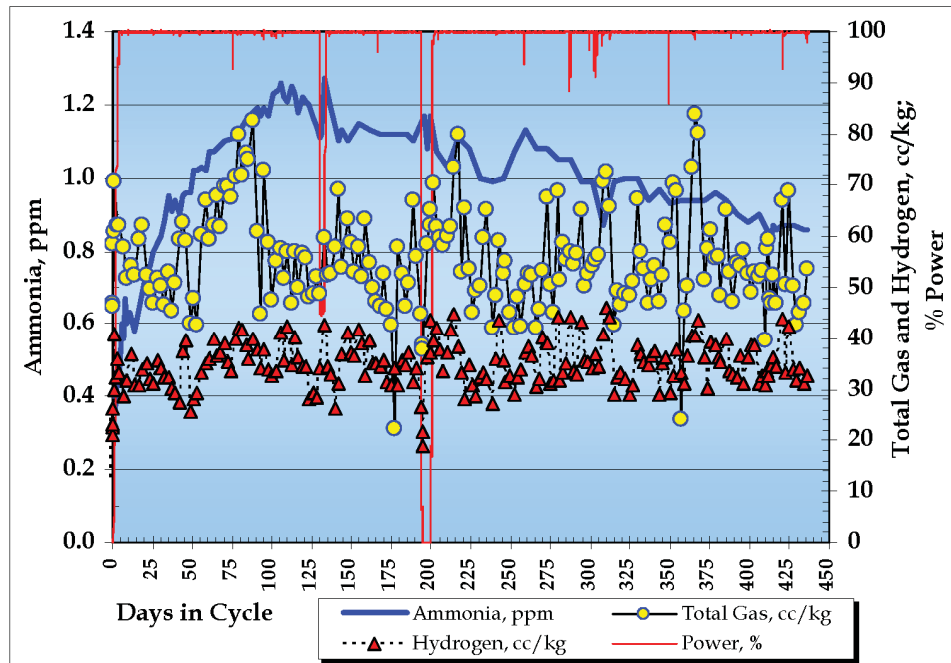


Figure 09.03.04-23-2–Control of Lithium in the Presence of Ammonia

