ENERGY*SOLUTIONS*

May 12, 2016
ES/NRC 16-011
Docket No. 71-9168

ATTN: Document Control Desk
Director, Division of Spent Fuel Management
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: **Response to Request for Additional Information for the Model No. 8-120B Package, TAC No. L25082**

Reference: Letter from P. Saverot (NRC) to S. Sisley (Energy*Solutions*), "Request for Additional Information for the Review of the Model No. 8-120B Package," Docket No. 71-9168, TAC No. L25082, March 9, 2016.

Dear Sir or Madam:

By the referenced letter, NRC requested that Energy*Solutions* (ES) provide additional information needed for NRC staff to complete their review of the application to amend Certificate of Compliance (CoC) No. 9168 for the 8-120B Shipping Package. ES hereby provides the additional information requested by NRC in the referenced letter. Enclosure 1 contains one paper copy of the non-public version of the RAI response that contains proprietary information that should be withheld under 10 CFR 2.390. Enclosure 2 contains one (1) paper copy of the non-public version of the revised 8-120B Safety Analysis Report (SAR) that contains security-related sensitive information that should be withheld under 10 CFR 2.390. Enclosures 3 and 4 contain one paper copy each of the public versions of the RAI response and the revised 8-120B SAR, respectively, in which all proprietary or security-related sensitive information is redacted. A summary of changes included in the 8-120B SAR is provided in Attachment 1 of this letter. An affidavit containing a full statement of the reasons that the proprietary information in the RAI response should be withheld from the public, pursuant to the requirements of 10 CFR 2.390, is included in Attachment 2 of this letter.

Should you or any member of your staff have questions, please contact the undersigned at (408) 558-3509.

Sincerely,

Steven E. Sisley
Cask Licensing Manager
Energy*Solutions*

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Attachments:
(1) Summary of Changes, 8-120B Consolidated SAR, Revision 11 (2 pages)
(2) Affidavit pursuant to 10 CFR 2.390.

Enclosures:
1) Response to Request for Additional Information (1 paper copy), Non-Public Version **(Proprietary Information – Withhold Under 10 CFR 2.390).**
2) Safety Analysis Report for the Model 8-120B Type B Shipping Packaging, Consolidated Revision 11, May 2016, Non-Public Version (1 paper copy), **(Security-Related Information – Withhold Under 10 CFR 2.390).**
3) Response to Request for Additional Information (1 paper copy), Public Version.
4) Safety Analysis Report for the Model 8-120B Type B Shipping Packaging, Consolidated Revision 11, May 2016, Public Version (1 paper copy).

cc
Mr. Pierre Saverot, Division of Spent Fuel Management
Mr. Dan Shrum, Energy*Solutions*

The following is a summary of the changes incorporated in Consolidated Revision 11 of the 8-120B Safety Analysis Report (SAR). The revisions indicators in the margins of Consolidated Revision 10 of the 8-120B SAR have also been included in Consolidated Revision 11 to indicate the cumulative changes that have been made in association with the request to amend the 8-120B CoC. However, the summary of the changes incorporated in Consolidated Revision 10 of the 8-120B SAR are not repeated below.

Summary of Changes, 8-120B SAR, Consolidated Revision 11 (2 pages)

Section	Page(s)	Change	Purpose
2.6.1.1	2-23	Correction to gas temperature used to determine MNOP.	Editorial correction.
2.6.1.2	2-24	Added evaluation of differential thermal expansion between resin contents and secondary container for NCT heat condition.	Revised in response to RAI question 3-1.
2.6.2	2-26	Added evaluation of differential thermal expansion between resin contents and secondary container for NCT cold condition.	Revised in response to RAI question 3-1.
2.7.4.2	2-57, 2-58	Added evaluation of differential thermal expansion between resin contents and secondary container for HAC fire condition.	Revised in response to RAI question 3-1.
7.1.21.3	7-5	Step divided into multiple sub-steps for clarity.	Editorial change.
7.1.21.3	7-5	Added sub-step (a) requiring confirmation of secondary container seal and 10% free volume for grossly dewatered resin shipments.	Revised in response to RAI question 3-1.
Chapter 7, Attachment 1, Qualification Procedure	7-12	Step 3, last bullet revised to include guidance on treatment of free standing water for calculated source strength density of grossly dewatered resin shipment.	Revised in response to RAI question 7-1.
Chapter 7, Attachment 2	7-25	Step 1 revised to allow 10-day LSA exemption only for dry or dewatered contents.	Revised in response to RAI question 4-1.

Summary of Changes, 8-120B SAR, Consolidated Revision 11 (2 pages)

Section	Page(s)	Change	Purpose
Chapter 7, Attachment 2	7-25	Step 2 revised to clarify requirement for void space inside secondary container for resin shipments.	Revised in response to RAI question 4-1.
Chapter 7, Attachment 2	7-25	Step 3 revised to require that the permeability of the vent path be considered in the determination of the hydrogen concentration.	Revised in response to RAI question 4-1.
Chapter 7, Attachment 2	7-25	Step 5 revised to include guidance on calculation of the effective G-value for resin contents.	Revised in response to RAI question 4-1.

AFFIDAVIT PURSUANT TO 10 CFR 2.390

State of California)
) SS.
County of Santa Clara)

I, Steven E. Sisley, depose and say as follows:

(1) I am Cask Licensing Manager of Energy*Solutions*, and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been duly authorized to apply for its withholding.

(2) The information sought to be withheld is contained in the document listed in Table 1. This document has been appropriately designated as proprietary.

TABLE 1

Document No.	Document Title	Rev/Date
ES/NRC 16-011, Enclosure 1	Response to Request for Additional Information for the Model No. 8-120B Package, TAC No. L25082	May 12, 2016

(3) I have personal knowledge of the criteria and procedures used by Energy*Solutions* in designating information as trade secret, privileged, or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of 10 CFR 2.390, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure, including the information as designated in paragraph (2) above, should be withheld.

(i) The information sought to be withheld from public disclosure is included in the report documenting information which is owned and has been held in confidence by Energy*Solutions*.

(ii) The information is of a type customarily held in confidence by Energy*Solutions* and not customarily disclosed to the public. Energy*Solutions* has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Energy*Solutions'* policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process or component, structure, tool, method, etc., and the prevention of its use by Energy*Solutions*' competitors, without license from Energy*Solutions*, gives Energy*Solutions* a competitive economic advantage.

(b) The information consists of supporting data (including test data) relative to a process or component, structure, tool, method, etc. and gives Energy*Solutions* a competitive economic advantage, e.g., by optimization or improved marketability.

(c) The information, if used by a competitor, would reduce the competitor's expenditure of resources or improve the competitor's advantage in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.

(d) The information reveals cost or price information, production capacities, budget levels, or commercial strategies of Energy*Solutions*, its customers or suppliers.

(e) The information reveals aspects of past, present, or future Energy*Solutions* or customer funded development plans and programs of potential commercial value to Energy*Solutions*.

(f) The information contains patentable ideas, for which patent protection may be desirable.

(g) The information is third-party Proprietary Information.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR 2.390, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked and being transmitted by Energy*Solutions* to the Document Control Desk. The proprietary information has been presented to the Nuclear Regulatory Commission and is being voluntarily provided by Energy*Solutions*.

(vi) Public disclosure of the information is likely to cause substantial harm to the competitive position of Energy*Solutions* because:

(a) Similar products are manufactured and sold by competitors of Energy*Solutions*.

(b) The development of this information by Energy*Solutions* is the result of a significant expenditure of staff effort and a considerable sum of money. To the best of my knowledge and belief, a competitor would have to undergo similar effort and expense in generating equivalent information.

(c) In order to acquire such information, a competitor would also require considerable time and inconvenience.

(d) The information consists of detailed descriptions, properties and test data. The availability of such information to competitors would enable them to modify their product to better compete with Energy*Solutions*, take marketing or other actions to improve their product's position or impair the position of Energy*Solutions*' product, and avoid developing fabrication data in support of their processes, methods, and/or apparatus.

(e) In pricing Energy*Solutions*' products and services, significant research, development, engineering, analytical, licensing, fabrication, quality assurance and other costs must be included. The ability of Energy*Solutions*' competitors to utilize such information without similar expenditure of resources may enable them to sell their product at prices reflecting significantly lower costs.

Further the deponent sayeth not.

I declare under penalty of perjury that the forgoing is true and correct.

Executed on 12 MAY 2016

Date

Steven E. Sisley
Cask Licensing Manager
Energy*Solutions*

Enclosure 3

Response to Request for Additional Information
Public Version
(1 paper copy)

The response to the NRC's Request for Additional Information (RAI) associated with the Energy*Solutions* (ES) request to amend the Certificate of Compliance (CoC) for the 8-120B Package to include grossly dewatered resin is provided herein. Each RAI question is repeated herein and followed by the ES response and a summary of the resulting changes to the 8-120B Safety Analysis Report (SAR).

1-1 *Define the upper limit of the percentage of water for the grossly dewatered resin content in Section 1.2.2.1 of the application and ensure this limit is addressed and upheld in Chapter 7, "Operating Procedure," of the application.*

In Section 1.2.2.1 of the application, grossly dewatered resins are defined as an industry term applied to resins that have not been processed to reduce the water content further than that which can be obtained by pumping water out of the liner until the pump loses suction. The upper limit of the percentage of water of the contents has not been defined in Chapter 1 of the application or addressed in Chapter 7 of the application. This is necessary to allow for thermal expansion of the contents, and ensure the combustible gases generated in the package during the shipping period do not exceed 5%, by volume, of the free gas volume.

This information is required by the staff to determine compliance with 10 CFR 71.33(b)(3).

Response to 1-1:

Determining the percentage of water present in grossly dewatered resin may be impractical under field conditions, and is not necessary to allow for thermal expansion of the contents and ensure that combustible gases do not exceed 5%. Instead, differential thermal expansion between the resin contents and the secondary container has been evaluated for NCT heat, NCT cold, and HAC fire conditions to establish the minimum required void space (10%) within the secondary container to assure free thermal expansion of the resin contents within the secondary container (see response to 3-1.) In addition, the directions for hydrogen calculations provided in Attachment 2 to SAR Chapter 7 have been revised to provide guidance for calculating the void volume within the secondary container when the amount of free space can be established, and another more conservative method that assumes the resin is fully flooded. In this latter case, the only credited free volume space within the secondary container is the ullage.

Summary of SAR Changes

- See responses to 3-1 and 4-1.

3-1 *Provide calculations in Chapter 3 of the application to demonstrate that there is adequate space for expansion of the grossly dewatered resin content and free water in the secondary container during normal conditions of transport and hypothetical accident conditions.*

It has not been demonstrated in the application that there is adequate space for expansion

of the grossly dewatered resin contents within the secondary container due to temperature increases during normal conditions of transport and hypothetical accident conditions, considering the grossly dewatered resin contents as well as the percentage of free water of the contents.

This information is required by the staff to determine compliance with 10 CFR 71.87(d).

Response to 3-1:

An evaluation of thermal expansion of grossly dewatered resin within the secondary container has been performed for NCT and HAC conditions. It concludes that if the secondary container has 10% or more free volume (in the form of ullage and/or interstitial void space within the resin), the secondary container has adequate space for free thermal expansion of the resin contents.

Summary of SAR Changes

- Section 2.6.1.2: Added evaluation of differential thermal expansion between grossly dewatered resin contents and the secondary container for the NCT heat condition.
- Section 2.6.2: Added evaluation of differential thermal expansion between grossly dewatered resin contents and the secondary container for the NCT cold condition.
- Section 2.7.4.2: Added evaluation of differential thermal expansion between grossly dewatered resin contents and the secondary container for the HAC fire condition.
- Section 7.1.21.3: Editorial reformatting and editing of section; Added requirement to confirm that secondary container is adequately sealed and there is at least 10% free volume within the secondary container, in the form of ullage and/or interstitial void space, when shipping grossly dewatered resin or any contents with significant liquid content.

4-1 *Demonstrate that combustible gases generated in the package during the shipping period do not exceed 5%, by volume, of the free gas volume.*

Grossly dewatered resins are defined in the application as an industry term applied to resins that have not been processed to reduce the water content further than that which can be obtained by pumping water out of the liner until the pump loses suction.

Section 1.2.2.3 of the application states that, for any package containing water and/or organic substances which could generate combustible gases by radiolysis, the hydrogen generated must be limited to a molar quantity that would be less than 5% by volume of the secondary container gas void, if present at STP.

The applicant needs to perform a bounding calculation of the combustible gases that could form with grossly dewatered resins as authorized contents, and ensure that the hydrogen

concentration within the container will be below 5%, by volume, of the free gas volume.

This information is required by the staff to determine compliance with 10 CFR 71.43(d).

Response to 4-1:

The buildup of combustible gases generated by the contents during shipments of resins, filter media, and sludges is highly dependent on the parameters for the particular shipment. It is sensitive to the shipping period, total decay energy, waste isotopic content, waste material properties, free water content, temperature, secondary container properties, cribbing properties (if used), and loading practices. For this reason, shippers are currently required by Section 7.0 of the SAR to determine the hydrogen concentration per Attachment 2 to Chapter 7 for certain shipments with contents that can generate hydrogen through radiolysis. The NRC Staff found this approach to be acceptable in the Safety Evaluation Report (SER) for revision 19 of the 8-120B Certificate of Compliance. Energy*Solutions* does not propose changing the current practice because truly bounding combustible gas evaluations have limited usefulness under real field conditions. Instead, it is demonstrated for several representative contents that the grossly dewatered resin can be shipped within the limits for combustible gas generation. Specifically, sample hydrogen calculations are performed for four sample shipments:

Case	Water Content	Source Term
A	Fully Flooded	Slightly above LSA
B	Fully Flooded	Maximum Allowed
C	Grossly Dewatered (20%)	Maximum Allowed
D	Dewatered (1%) [reference case]	Maximum Allowed

Furthermore, the current guidance/requirements for the gas generation evaluation provided in the SAR is evaluated to determine whether it adequately address combustible gas generation for grossly dewatered resin shipments, and revised as necessary.

Background

Shippers are currently required by Section 7.0 of the SAR to determine the hydrogen concentration per Attachment 2 to Chapter 7 for contents that can generate hydrogen through radiolysis. Attachment 2 currently specifies that for LSA shipments made within 10 days of preparation or venting the secondary container, hydrogen generation analysis is not required. This is consistent with the clarifications made in NRC Information Notice 84-72. Based on 8-120B operating history, the great majority of resin shipments fall under the LSA rule, and thus do not require hydrogen calculations. All other shipments of Type B quantities that can generate hydrogen through radiolysis must be evaluated per NUREG/CR-6673 using the methodology in Section 4.2.2.1 "Hydrogen Gas Concentration in a Rigid Leaking Enclosure Nested Within a Rigid Non-Leaking Enclosure."

Sample Hydrogen Calculations

In order to demonstrate that grossly dewatered resin shipments in the 8-120B can meet the 5% hydrogen concentration limits, calculations were performed for the four sample shipments of bead resin listed above. Details of the analyses are presented in Attachment A to this RAI response. The conclusions from the hydrogen calculations are:

- Cases A and B show that even fully-flooded resins are acceptable, but additional free volume may be required beyond the minimum necessary for thermal expansion (see the response to question 3-1). A free volume of 10% was found to be acceptable for Case A Proprietary Information - (4)(ii)(b)

- Cases B and C show that when the amount of interstitial void space can be determined, even the high heat load case can be accommodated with minimal ullage. For these examples, Case B required Proprietary Information - (4)(ii)(b)
  Case C had the same parameters, except that the resin was assumed to have 20% free standing water content, and 10% ullage produced acceptable results.

- Case D for dewatered resin shows that for the high heat load case, the interstitial void space within the resin column is sufficient to reduce hydrogen buildup to within acceptable levels with virtually no ullage.

Discussions of the results for each case are as follows.

Proprietary Information - (4)(ii)(b)

Proprietary Information - (4)(ii)(b)

Proprietary Information - (4)(ii)(b)

Proprietary Information - (4)(ii)(b)

Evaluation of Current CoC Requirements With Respect to Combustible Gas Generation in Gross Dewatered Resin

Issue #1 - Can shipments of grossly dewatered resins meet hydrogen limits?

The examples above demonstrate that grossly dewatered resin shipments are feasible and can be evaluated using the methodology of NUREG/CR-6673, as required by Attachment 2 to SAR Chapter 7. The methodology is applicable to both dewatered and grossly dewatered contents because NUREG/CR-6673 includes considerations for effects of additional water on G values and the resulting reduction of available free volume. Shippers can evaluate hydrogen generation in their grossly dewatered resin in either of two ways:

- When the shipper can determine the water content of grossly dewatered resin, credit may be taken in the gas generation calculations for the full free volume in the secondary container (including both the ullage and interstitial void volumes), or

- When the water content of grossly dewatered resin cannot be readily determined, assume that the resin is fully flooded and only take credit for the ullage space in the gas generation calculations.

It is therefore neither necessary nor desirable to define a limit on the water content of grossly dewatered resin.

Issue #2 - Is the current exemption for 10-day LSA shipments still appropriate for grossly dewatered resin shipments?

The sample hydrogen calculation for Case A concluded that bead resin at approximately the LSA limit meets hydrogen requirements when shipments are prepared with 10% ullage and shipped within 10 days of closure of the secondary container. While the calculations meet the factor of two recommended by NUREG/CR-6673, the indicated margin is not significantly greater. Because of the wide variability in resin interstitial free space, G values, and other shipment parameters, Energy*Solutions* recommends that the 10-day LSA rule does not apply to shipments of grossly dewatered materials, and that hydrogen evaluations must always be performed for these shipments.

SAR Chapter 7, Attachment 2, Step 1 is revised to allow the 10-day LSA exemption only for dry or dewatered contents.

Issue #3 - Are the instructions in Attachment 2 of SAR Chapter 7 adequate for grossly dewatered resin shipments?

Attachment 2 of SAR Chapter 7 was reviewed with these example calculations in mind to determine if sufficient guidance is available for shippers to complete their required NUREG/CR-6673 evaluations. The steps were found to be suitable for grossly dewatered resin, although the following revisions were made to provide additional guidance or clarification:

- Step 2 is revised to clarify that for resin shipments, the secondary container void volume includes the ullage volume, plus the interstitial void volume only if the interstitial void volume of the grossly dewatered resin is known. If the interstitial void volume cannot be determined, then only the ullage space should be credited toward the secondary container void volume.

- Step 3 is revised to require that the permeability of the vent path be considered in the evaluation, or that the permeability shall be otherwise assumed zero.

- Step 5 is revised to caution shippers that when the amount of free standing water cannot be readily determined, use the relative volumes of the resin and the minimum known amount of free standing water to calculate the effective G value. This is because the G value for resin is generally higher than the G value for water.

Summary of SAR Changes

- Attachment 2 to SAR Chapter 7: Revised to include the additional guidance or clarification points described above.

4-2 *Specify in Chapters 7 and 8 of the application that written leakage rate testing procedures are developed and approved by personnel certified by the American Society of Nondestructive Testing (ASNT) as a Level III examiner for leakage testing.*

Chapters 7 and 8 of the application do not specify that the written leakage rate testing procedures are developed and approved by personnel certified by the ASNT as a Level III examiner for leakage testing as indicated by industry standards. The ANSI/ASNT CP-189-2006, "Standard for Qualification and Certification of Nondestructive Testing Personnel," provides the minimum training, education, and experience requirements for nondestructive testing personnel. This ANSI standard states that a nondestructive testing personnel Level III examiner has the qualifications to develop and approve written instruction for conducting the leak testing.

This information is required by the staff to determine compliance with 10 CFR 71.43(f), 71.51, and 71.87.

Response to 4-2:

Energy*Solutions* proposes to include this in a planned amendment request that will address broad scale upgrades to the containment and leak rate testing portions of the 8-120B SAR. We would prefer to perform all the related updates at once rather than implementing changes in separate amendments. We are aware of NRC Information Notice 2016-04, which requires no specific actions at this time, and will take ANSI N14.5-2014 into account while developing the amendment request.

Summary of SAR Changes

- None.

7-1 *Justify the inclusion of water in evaluating source strength density (γ/s·g) or modify the language in Attachment 1 to Chapter 7, "Operating Procedure" to exclude the weight of water in calculations of the source strength density.*

With grossly dewatered resins as authorized contents, there is some amount of water remaining that increases the mass of the package contents, thus allowing for higher radionuclide activity levels that would still meet the source strength density limits in Table 7-1 of Chapter 7, as long as the resins retain the water during transport.

Since resin shipments in the 8 120B are governed by the γ/s·g values in Table 7-1 of Chapter 7, there is a theoretical possibility that package dose rates could exceed regulatory limits, if a maximum resin load were to experience water migration (or leaching) to the extent that the top part of the payload locally exceeded the γ/s·g limit because the total payload weight is used to calculate γ/s·g.

The staff requests that the applicant provides either a new language in Chapter 7 to account for this possibility or additional information explaining how any remaining water in the resins could be prevented from migrating or leaching during transport.

This information is required by the staff to determine compliance with 10 CFR 71.47 and 10 CFR 71.51.

Response to 7-1:

The term "dewatered" means that the water used to sluice resins has generally been removed from the waste. When used in the waste acceptance context, "dewatered" means that the waste meets the disposal site's waste acceptance criterion, which is commonly 1.0 percent free standing water by volume. Note that free standing water is much different than total water content. Free standing water is the water that would escape if one punctured the bottom of the secondary container and collected the liquid that flowed out. The term "grossly dewatered" refers to the first step in the dewatering process, typically when suction breaks and no additional water can be easily collected from the waste. If the amount of free standing water in grossly dewatered resin was very large, then special care would be necessary when applying the γ/s·g limits.

Based on Energy*Solutions'* operational experience, the amount of free water content in grossly dewatered resins is on the order of ten gallons for an 8-120B shipment, which we would consider negligible from a shielding standpoint. Furthermore, field exposure rates cannot distinguish between grossly dewatered resins and resins in the dewatered state: there is no discernable change in exposure rates during the dewatering process.

We understand that operating experience alone may not be sufficient to argue that no

corrections should be made for the mass of the free standing water when applying the γ/s·g limits. Rather than place a hard limit on the amount of free standing water in grossly dewatered, Attachment 1 to Chapter 7, "Qualification Procedure" has been modified to require that the mass of free standing water be excluded in calculations of the source strength density for shipments of grossly dewatered resins.

Summary of SAR Changes

- Chapter 7, Attachment 1, "Qualification Procedure": Revise 5th bullet of Step 3 to note that the weight of free standing water shall be excluded when calculating of the source strength density for shipments of grossly dewatered resins.

Attachment A

Hydrogen Calculation Details

1 Methods and Assumptions:

1.1 Methodology

Radiolytic hydrogen generation is evaluated per NUREG/CR-6673 using the methodology in Section 4.2.2.1 "Hydrogen Gas Concentration in a Rigid Leaking Enclosure Nested Within a Rigid Non-Leaking Enclosure." This is the method required by Attachment 2 to SAR Chapter 7.

Four cases are evaluated for the various water contents and source terms shown below. The secondary container ullage was adjusted where necessary to meet hydrogen concentration limits.

Case	Water Content	Source Term
A	Fully Flooded	Slightly above LSA
B	Fully Flooded	Maximum Allowed
C	Grossly Dewatered (20%)	Maximum Allowed
D	Dewatered (1%) [reference case]	Maximum Allowed

Proprietary Information - (4)(ii)(b)

Proprietary Information - (4)(ii)(b)

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Proprietary Information - (4)(ii)(b)

Proprietary Information - (4)(ii)(b)

Proprietary Information - (4)(ii)(b)

Proprietary Information - (4)(ii)(b)

1.3.5 Results and Discussion

See the response to 4-1.