IN THE INTERNATIONAL BUREAU OF WIPO

International Application No. PCT/US2017/050125	§ §	Halliburton Energy Services, Inc.
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Title: Monte Carlo Modeling of Thorium Blanket Field Calibrators	§ § §	Authorized Office: Lee, Chang Ho

AMENDMENT UNDER PCT ARTICLE 19

Via e-PCT

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/Michelle Baxter/
Michelle Baxter

Dear Sirs:

In response to the International Search Report and Written Opinion mailed February 27, 2018, Applicant hereby requests entry of the amendments to the claims under Article 19 as reflected in the attached replacement claim sheets. A marked-up copy of the amendments made relative to the original as filed claims is also attached.

Claims 1 to 20 are pending in this application, of which claims 1, 11, and 20 are independent.

Basis for the amendments:

Claims 6 and 15 are amended to correct a typographical error in which the phrase "the second gammy ray tool" has been changed to "the second gamma ray tool" per Box VIII of the Written Opinion.

Claims 10 and 19 are amended to correct an antecedent basis issue by removing the word "the" from "the radioactive material" per Box VIII of the Written Opinion.

In addition, please note that a clean set of claims is attached hereto in the form of Replacement Sheets.

Applicant believes that no fees are due in connection with the present submission. However, the Office is hereby authorized to charge any fees that may be required (or to credit any overpayments), to Deposit Account 08-1394, Order No. 7523.1904WO01.

Respectfully submitted,

Dated: March 21, 2018

/Vinu Raj/

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MARKED-UP CLAIMS

WHAT IS CLAIMED IS:

1. (Original) A method of calibrating gamma ray tools using blanket field calibrator models, the method comprising:

simulating a counting rate of a first gamma ray tool based on a model of a first blanket calibrator;

determining whether the simulated counting rate matches a measured counting rate associated with the first gamma ray tool;

when the simulated counting rate is determined to match the measured counting rate, determining a tally multiplier and a corresponding material specification for the model of the first blanket calibrator;

simulating a counting rate for a second gamma ray tool based on the tally multiplier and the material specification determined for the model of the first blanket calibrator;

determining a sensitivity factor for the second gamma ray tool, based on the simulation; and

calibrating the second gamma ray tool according to a nominal blanket activity calculated from the sensitivity factor of the second gamma ray tool.

2. (Original) The method of claim 1, wherein the first gamma ray tool is a previously calibrated gamma ray tool having a known design or configuration and the second gamma ray tool is an uncalibrated gamma ray tool having a new design or configuration.

3. (Original) The method of claim 1, wherein the sensitivity factor is an American Petroleum Institute (API) unit sensitivity factor for the second gamma ray tool.

4. (Original) The method of claim 1, wherein the first blanket calibrator is a reference blanket calibrator.

5. (Original) The method of claim 1,

wherein simulating the counting rate for the second gamma ray tool further comprises:

simulating a first counting rate response of the second gamma ray tool to a low activity zone of a subsurface formation; and

simulating a second counting rate response of the second gamma ray tool to a high activity zone of the formation, and

wherein determining the sensitivity factor for the second gamma ray tool comprises:

calculating the sensitivity factor based on the simulated first and second counting rates.

6. (Currently Amended) The method of claim 1, wherein determining the sensitivity factor comprises:

calculating a tally multiplier for a model of a second blanket calibrator, based on the tally multiplier of the first blanket calibrator;

determining a thorium concentration corresponding to the tally multiplier of the model of the second blanket calibrator;

determining a material specification for the model of the second blanket calibrator, based on the thorium concentration;

simulating a counting rate for the second ~~gammy~~ gamma ray tool, based on the tally multiplier and the material specification determined for the model of the second blanket calibrator; and

calculating the sensitivity factor for the second gamma ray tool, based on the counting rates simulated for the respective first and second blankets.

7. (Original) The method of claim 6, wherein each of the first and second blanket calibrators include sheets of radioactive material.

8. (Original) The method of claim 7, wherein the radioactive material is radioactive monazite sand including at least one of thorium or uranium.

9. (Original) The method of claim 6, wherein the models of the first and second blanket calibrators are Monte Carlo models.

10. (Currently Amended) The method of claim 9, wherein the simulation of counting rates using the Monte Carlo models of the respective first and second blanket calibrators is performed based on an extended version of a Monte Carlo code for simulating correlated particle transport arising from cascade decay transitions of isotopes in [[the]] radioactive material associated with each blanket calibrator.

11. (Original) A system for calibrating gamma ray tools using blanket field calibrator models, the system comprising:

at least one processor; and

a memory coupled to the processor having instructions stored therein, which when executed by the processor, cause the processor to perform functions including functions to:

simulate a counting rate of a first gamma ray tool based on a model of a first blanket calibrator;

determine whether the simulated counting rate matches a measured counting rate associated with the first gamma ray tool;

when the simulated counting rate is determined to match the measured counting rate, determine a tally multiplier and a corresponding material specification for the model of the first blanket calibrator;

simulate a counting rate for a second gamma ray tool based on the tally multiplier and the material specification determined for the model of the first blanket calibrator;

determine a sensitivity factor for the second gamma ray tool, based on the simulation; and

calibrate the second gamma ray tool according to a nominal blanket activity calculated from the sensitivity factor of the second gamma ray tool.

12. (Original) The system of claim 11, wherein the first blanket calibrator is a reference blanket calibrator, the first gamma ray tool is a previously calibrated gamma ray tool having a known design or configuration, and the second gamma ray tool is an uncalibrated gamma ray tool having a new design or configuration.

13. (Original) The system of claim 11, wherein the sensitivity factor is an American Petroleum Institute (API) unit sensitivity factor for the second gamma ray tool.

14. (Original) The system of claim 11, wherein the functions performed by the processor further include functions to:

simulate a first counting rate response of the second gamma ray tool to a low activity zone of a subsurface formation;

simulate a second counting rate response of the second gamma ray tool to a high activity zone of the formation; and

calculate the sensitivity factor based on the simulated first and second counting rates.

15. (Currently Amended) The system of claim 11, wherein the functions performed by the processor further include functions to:

calculate a tally multiplier for a model of a second blanket calibrator, based on the tally multiplier of the first blanket calibrator;

determine a thorium concentration corresponding to the tally multiplier of the model of the second blanket calibrator;

determine a material specification for the model of the second blanket calibrator, based on the thorium concentration;

simulate a counting rate for the second ~~gammy~~ gamma ray tool, based on the tally multiplier and the material specification determined for the model of the second blanket calibrator; and

calculate the sensitivity factor for the second gamma ray tool, based on the counting rates simulated for the respective first and second blankets.

16. (Original) The system of claim 15, wherein each of the first and second blanket calibrators include sheets of radioactive material.

17. (Original) The system of claim 16, wherein the radioactive material is radioactive monazite sand including at least one of thorium or uranium.

18. (Original) The system of claim 15, wherein the models of the first and second blanket calibrators are Monte Carlo models.

19. (Currently Amended) The system of claim 18, wherein the simulation of counting rates using the Monte Carlo models of the respective first and second blanket calibrators is performed based on an extended version of a Monte Carlo code for simulating correlated particle transport arising from cascade decay transitions of isotopes in [[the]] radioactive material associated with each blanket calibrator.

20. (Original) A computer-readable storage medium having instructions stored therein, which when executed by a computer cause the computer to perform a plurality of functions, including functions to:

simulate a counting rate of a first gamma ray tool based on a model of a first blanket calibrator;

determine whether the simulated counting rate matches a measured counting rate associated with the first gamma ray tool;

when the simulated counting rate is determined to match the measured counting rate, determine a tally multiplier and a corresponding material specification for the model of the first blanket calibrator;

simulate a counting rate for a second gamma ray tool based on the tally multiplier and the material specification determined for the model of the first blanket calibrator;

determine a sensitivity factor for the second gamma ray tool, based on the simulation; and

calibrate the second gamma ray tool according to a nominal blanket activity calculated from the sensitivity factor of the second gamma ray tool.