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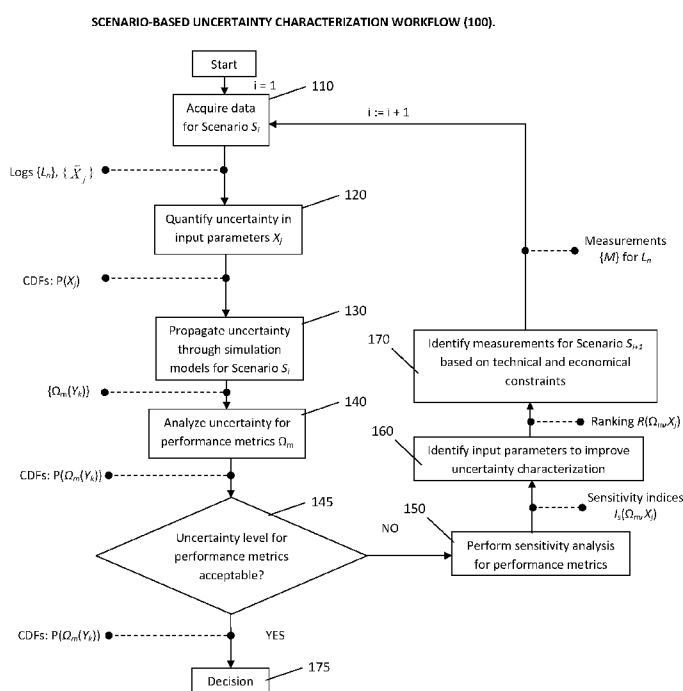
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[Continued on next page]

(54) Title: METHOD FOR UNCERTAINTY QUANTIFICATION IN THE PERFORMANCE AND RISK ASSESSMENT OF A CARBON DIOXIDE STORAGE SITE



(57) Abstract: A CO₂ sequestration site is evaluated by incorporating a consistent petrophysical framework having uncertainties expressed in the form of probability density functions of wellbore measurements, by systematically propagating the uncertainties in generating probability density functions or cumulative distribution functions of the parameters used in a reservoir simulation, by using the reservoir simulation to transform the first set of parameters into output variables with uncertainties, and by using the output variables and uncertainties to generate an answer product from which uncertainty levels of performance metrics can be ascertained.



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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & "Keywords : carbon, dioxide, sequestration, parameter, uncertainty, and similar terms"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2008-0005304 A1 (DIAO, Y. et al.) 03 January 2008 See the whole document.	1-22
A	US 7457758 B2 (ZIMMERMAN, P. R.) 25 November 2008 See the whole document.	1-22
A	US 2002-0184069 A1 (KOSIBA, E. D. et al.) 05 December 2002 See the whole document.	1-22
A	US 2008-0015829 A1 (JANDHYALA, V. et al.) 17 January 2008 See the whole document.	1-22



Further documents are listed in the continuation of Box C.



See patent family annex.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008-0005304 A1	03.01.2008	US 2008-005304 A1	03.01.2008
US 7457758 B2	25.11.2008	AU 2004-211783 A1	26.08.2004
		CA 2531181-A1	26.08.2004
		EP 1631871 A4	02.11.2006
		NZ 542322A	30.11.2007
		US 2004-0158478 A1	12.08.2004
		WO 2004-072801 A2	26.08.2004
		ZA200507299A	25.10.2006
US 2002-0184069 A1	05.12.2002	US 2005-0065837 A1	24.03.2005
US 2008-0015829 A1	17.01.2008	US 2008-015829 A1	17.01.2008