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(54) SYSTEMS AND METHODS FOR STARTING, RESTARTING, MONITORING AND INCREASING PERFORMANCE OF A PRODUCTION AND/OR INJECTION SYSTEM

(57) A system (10) includes a distributed control system (20) and a subsea tree (56) that includes subsea tree chokes (136) and a subsea control module (38) communicatively coupled to flow control valves (126). The distributed control system (20) communicatively couples to the subsea control module (38), is located at a surface level, and includes processors (27) that send a first instruction to the flow control valves (126) to adjust hydrocarbon production flow when water or gas cut is above a threshold. The processors (27) also send a second instruction to the subsea tree chokes to adjust the flow of the production when a quality of commingling of the production flow with additional production flows is less than a threshold, an arrival pressure is less than a threshold, or an arrival flow rate is less than a threshold. The processors further continue the production of the fluids with current settings when a production rate is above a production rate threshold.

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EUROPEAN SEARCH REPORT

Application Number
EP 17 20 7246

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2005/236155 A1 (KILLIE RUNE [US] ET AL) 27 October 2005 (2005-10-27) * paragraphs [0023], [0025], [0036], [0047], [0060], [0061]; figures 1, 2, 3 * * the whole document *	1-11	INV. E21B33/035
A	US 2011/251728 A1 (BATHO PETER [US] ET AL) 13 October 2011 (2011-10-13) * the whole document *	1-11	
A	WO 2014/003754 A1 (FMC TECHNOLOGIES [US]; HAMILTON SCOTT [GB]; SMEDSTAD ERIC R [US]; HART) 3 January 2014 (2014-01-03) * the whole document *	1-11	
A	GB 2 447 331 A (SCHLUMBERGER HOLDINGS [VG]) 10 September 2008 (2008-09-10) * the whole document *	1-11	

TECHNICAL FIELDS SEARCHED (IPC)

E21B

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
Munich	25 April 2018	Patrascu, Bogdan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-11

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-11

A system for starting production of fluids comprising hydrocarbons from a well disposed in a reservoir located at a subsurface level, comprising: a subsea tree coupled to the well and configured to control a flow of the production of the fluids comprising the hydrocarbons, wherein the subsea tree comprises: one or more subsea tree chokes configured to control the flow of the production at the subsea tree;one or more subsea tree valves configured to at least partially enable the flow of the production, inject additional fluids, inject gas, or any combination thereof, at the subsea tree; and a subsea control module configured to communicatively couple to one or more flow control valves located in the well, the one or more subsea tree chokes, the one or more subsea tree valves, or any combination thereof, wherein the one or more flow control valves are configured to reduce water cut in the production, reduce gas cut in the production, control the flow of the production at the well, reduce solids in the production, or any combination thereof;a distributed control system communicatively coupled to the subsea control module and located at a surface level, wherein the distributed control system comprises one or more processors configured to: send a first instruction to the one or more flow control valves to adjust the flow of the production of the well when the water cut or the gas cut in the production is above a water cut threshold or a gas cut threshold;send a second instruction to the one or more subsea tree chokes to adjust the flow of the production when a quality of commingling of the flow of the production with one or more additional flows of production from one or more additional wells is less than a commingling threshold, an arrival pressure is less than an arrival pressure threshold, or an arrival flow rate is less than an arrival flow rate threshold; and continue the production of the fluids comprising the hydrocarbons with current settings when a rate of the production is above a production rate threshold.

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2. claims: 12-18

A system for restarting production of fluids comprising hydrocarbons from a well after stopping the production, comprising: the well configured to produce the fluids comprising hydrocarbons from a hydrocarbon reservoir;a subsea tree mounted to the well and configured to transfer the production of the hydrocarbons from the well, wherein the subsea tree comprises a subsea control module configured to control one or more subsea components of the system;a plurality of pipelines configured to transfer the production of the fluids at least partially from the subsea tree to a

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surface level, wherein the plurality of pipelines comprises a flowline configured to transfer the production of the fluids from the subsea tree to a riser coupled to the flowline, wherein the riser is configured to transfer the production of the fluids from the flowline to the surface level;a gas injection system coupled to the subsea tree and the well and configured to inject gas into the subsea tree and the well;a pig launcher configured to displace the production with dead oil;a distributed control system communicatively coupled to the subsea control module and located at the surface level, wherein distributed control system comprises one or more processors configured to: send a first instruction to the gas injection system to inject the gas into the subsea tree to preserve the subsea tree;send a second instruction to the pig launcher to displace the production in at least one pipeline of the plurality of pipelines with the dead oil to preserve the at least one pipeline;send a third instruction to the gas injection system to inject the gas into the well to preserve the well; and restart the production at the well.

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3. claims: 19-26

A system for monitoring and increasing performance of production of fluids comprising hydrocarbons from a well, comprising: the well configured to produce the fluids comprising the hydrocarbons from a hydrocarbon reservoir, wherein one or more flow control devices and one or more inflow control devices are located in the well, wherein the one or more flow control devices are configured to reduce water cut in the production, reduce gas cut in the production, control a flow of the production at the well, or any combination thereof, wherein the one or more inflow control devices are configured to reduce flow of one or more undesired liquids into the well, from the well, or a combination thereof;a subsea tree mounted to the well and configured to transfer the production of fluids comprising the hydrocarbons from the well to a pipeline end manifold, wherein the subsea control module is configured to control one or more subsea components of the system, wherein at least the first choke is configured to control the flow of the production at the subsea tree;a distributed control system communicatively coupled to the subsea control module and located at a surface level, wherein the distributed control system comprises one or more processors configured to: send a first instruction to adjust the one or more flow control devices, the one or more inflow control devices, at least the first choke, at least the second choke, or any combination thereof, when the water cut or a solid production in the production is above a water cut threshold

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or a solid production threshold;determine whether a measured flow rate, a measured pressure, a measured temperature, or any combination thereof, approximately matches a flow rate, pressure, a temperature, or any combination thereof, of the production corresponding to increasing the production;send a second instruction to adjust the one or more flow control devices, the one or more inflow control devices, or any combination thereof, when the measured flow rate, the measured pressure, the measured temperature, or any combination, does not approximately match; and continue the production with current settings when the measured flow rate, the measured pressure, the measured temperature, or any combination, approximately matches the flow rate, the pressure, the temperature, or any combination thereof, corresponding to increasing the production.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 20 7246

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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25-04-2018

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82