CLAIMS

1. A system for regulating drilling fluid pressure, the system comprising:

at least one surface drilling fluid pump connected to discharge piping connected to an inlet of the well bore, said pump operable to discharge drilling fluid through the discharge piping at a drilling fluid flow rate;

a pressure control device having an inlet connected to the discharge piping and having an outlet connected to bypass piping; and

a processor connected to the surface drilling fluid pump and the pressure control device, the processor operable to:

receive pressure measurement signals representative of a pressure of the drilling fluid in the discharge piping,

determine that a target pressure parameter of the drilling fluid in the discharge piping is not satisfied,

in response to determining that the target pressure parameter is not satisfied, adjust the pressure control device to modify the pressure of the drilling fluid in the discharge piping to approach the target pressure parameter by at least partially opening the pressure control device and releasing drilling fluid into the bypass piping at a selected flow rate, and

modify the drilling fluid flow rate in the discharge piping based on the pressure represented by the pressure measurement signals and the selected flow rate in the bypass piping such that the target pressure parameter of the drilling fluid in the discharge piping is satisfied.

2. The system of claim 1, wherein the target pressure parameter in the discharge piping corresponds to a drill pipe pressure schedule according to which the drilling fluid pump discharges the drilling fluid through the discharge piping, and wherein the processor is further operable to modify the drilling fluid flow rate in the discharge piping based on the pressure represented by the pressure measurement signals and the selected flow rate to satisfy the drill pipe pressure schedule.

3. The system of claim 1 or 2, wherein the processor is further operable to determine the selected flow rate at which the at least partially open pressure control device releases the drilling fluid.

4. The system of claim 3, wherein, to determine the selected flow rate the processor is operable to:

identify one or more data pairs, each data pair including a flow rate of drilling fluid through the bypass piping and a pressure in the bypass piping;

provide the flow rate of drilling fluid through the bypass piping and the pressure in the bypass piping included in each data pair of the identified one or more data pairs as an input to a curve fit function, and

execute the curve fit function to determine the selected flow rate at which the at least partially open pressure control device releases the drilling fluid.

5. The system of claim 4, further comprising a computer-readable storage medium storing a plurality of data pairs, each data pair including a flow rate of drilling fluid through the bypass piping and a pressure in the bypass piping, wherein the plurality of data pairs include the identified one or more data pairs, and wherein the processor is further operable to:

measure a plurality of flow rates of drilling fluid through the bypass piping;

measure a plurality of pressures in the bypass piping, each pressure measured for a corresponding flow rate of the plurality of flow rates; and

store the measured plurality of flow rates and the plurality of pressures on the computer-readable storage medium as the plurality of data pairs.

6. The system of claim 4, wherein the processor is further operable to:

identify a subset of the plurality of data pairs;

provide each flow rate of drilling fluid and each pressure in the bypass piping included in each data pair in the subset to a curve fit function;

execute the curve fit function to determine a modified drilling fluid flow rate.

7. The system of claim 3, further comprising a flow meter connected to the pressure control device to measure a flow rate at which the pressure control device releases the drilling fluid.

8. The system of claim 7, wherein the processor is further operable to:

receive the flow rate measured by the flow meter connected to the pressure control device; and

compare the flow rate measured by the flow meter to the selected flow rate.

9. The system of claim 1, further comprising a transmitter in electronic communication with the processor to transmit control signals to at least partially open the pressure control device to release the drilling fluid at the selected flow rate.

10. The system of claim 1, further comprising a flow meter connected to the drilling fluid pump to measure the drilling fluid flow rate through the bypass piping.

11. A computer-implemented method to regulate drilling fluid pressure, the method comprising:

receiving pressure measurement signals representative of a pressure of a drilling fluid discharged by at least one drilling fluid pump into a discharge piping at a drilling fluid flow rate, wherein the drilling fluid pump has an inlet connected to the discharge piping and has an outlet connected to bypass piping;

determine that a target pressure parameter of the drilling fluid in the discharge piping is not satisfied;

in response to determining that the target pressure parameter is not satisfied, adjust a pressure control device to modify the pressure of the drilling fluid in the discharge piping to approach the target pressure parameter by at least partially opening the pressure control device and releasing drilling fluid into a bypass piping at a selected

flow rate, wherein the pressure control device is connected at an inlet to the discharge piping and at an outlet to bypass piping; and

modifying the drilling fluid flow rate in the discharge piping based on the pressure represented by the pressure measurement signals and the selected flow rate in the bypass piping such that the target pressure parameter of the drilling fluid in the discharge piping is satisfied.

12. The method of claim 11, wherein the target pressure parameter in the discharge piping corresponds to a drilling fluid drill pipe pressure schedule according to which the drilling fluid pump discharges the drilling fluid through the discharge piping, and wherein the method further comprises modifying the drilling fluid flow rate in the discharge piping based on the pressure represented by the pressure measurement signals and the selected flow rate to satisfy the drill pipe pressure schedule.

13. The method of claim 11 or 12, further comprising determining the selected flow rate at which the at least partially open pressure control device releases the drilling fluid.

14. The method of claim 13, further comprising, to determine the selected flow rate:

identifying one or more data pairs, each data pair including a flow rate of drilling fluid through the bypass piping and a pressure in the bypass piping;

providing the flow rate of drilling fluid through the bypass piping and the pressure in the bypass piping included in each data pair of the identified one or more data pairs as an input to a curve fit function; and

executing the curve fit function to determine the selected flow rate at which the at least partially open pressure control device releases the drilling fluid.

15. The method of claim 14, further comprising:

measuring a plurality of flow rates of drilling fluid through the bypass piping;

measuring a plurality of pressures in the bypass piping, each pressure measured for a corresponding flow rate of the plurality of flow rates; and

storing the plurality of flow rates and the plurality of pressures as a plurality of data pairs which include the identified one or more data pairs.

16. The method of claim 13, further comprising:

measuring a flow rate at which the pressure relief device releases the drilling fluid; and

comparing the flow rate to the selected flow rate.

17. The method of claim 13, further comprising:

identifying a subset of the plurality of data pairs;

providing each flow rate of drilling fluid and each pressure in the bypass piping included in each data pair in the subset to a curve fit function; and

executing the curve fit function to determine a modified drilling fluid flow rate.

18. The method of claim 11, further comprising transmitting control signals to at least partially open the pressure control device to release the drilling fluid at the selected flow rate.

19. The method of claim 11, further comprising measuring the drilling fluid flow rate through the bypass piping.

20. A computer-readable medium storing instructions executable by one or more processors to perform operations comprising:

receiving pressure measurement signals representative of a pressure of a drilling fluid discharged by at least one drilling fluid pump into a discharge piping at a drilling fluid flow rate, wherein the drilling fluid pump has an inlet connected to the discharge piping and has an outlet connected to bypass piping;

determine that a target pressure parameter of the drilling fluid in the discharge piping is not satisfied;

in response to determining that the target pressure parameter is not satisfied, adjust a pressure control device to modify the pressure of the pressure of the drilling fluid in the discharge piping to approach the target pressure parameter by at least partially opening the pressure control device and releasing drilling fluid into a bypass piping at a selected flow rate, wherein the pressure control device is connected at an inlet to the discharge piping and at an outlet to bypass piping; and

modifying the drilling fluid flow rate in the discharge piping based on the pressure represented by the pressure measurement signals and the selected flow rate in the bypass piping such that the target pressure parameter of the drilling fluid in the discharge piping is satisfied.

CLAIMS

1. A system for regulating drilling fluid pressure, the system comprising:

at least one surface drilling fluid pump connected to discharge piping connected to an inlet of the well bore, said pump operable to discharge drilling fluid through the discharge piping at a drilling fluid flow rate;

a pressure control device having an inlet connected to the discharge piping and having an outlet connected to bypass piping; and

a processor connected to the surface drilling fluid pump and the pressure control device, the processor operable to:

receive pressure measurement signals representative of a pressure of the drilling fluid in the discharge piping,

determine that a target pressure parameter of the drilling fluid in the discharge piping is not satisfied,

in response to determining that the target pressure parameter is not satisfied, adjust the pressure control device to modify the pressure of the drilling fluid in the discharge piping to approach the target pressure parameter by at least partially opening the pressure control device and releasing drilling fluid into the bypass piping at a selected flow rate,

determine the selected flow rate at which the at least partially open pressure control device releases the drilling fluid by:

identifying one or more data pairs, each data pair including a flow rate of drilling fluid through the bypass piping and a pressure in the bypass piping;

providing the flow rate of drilling fluid through the bypass piping and the pressure in the bypass piping included in each data pair of the identified one or more data pairs as an input to a curve fit function;

executing the curve fit function to determine the selected flow rate at which the at least partially open pressure control device releases the drilling fluid; and

modify the drilling fluid flow rate in the discharge piping based on the pressure represented by the pressure measurement signals and the selected flow rate in the bypass piping such that the target pressure parameter of the drilling fluid in the discharge piping is satisfied.

2. The system of claim 1, wherein the target pressure parameter in the discharge piping corresponds to a drill pipe pressure schedule according to which the drilling fluid pump discharges the drilling fluid through the discharge piping, and wherein the processor is further operable to modify the drilling fluid flow rate in the discharge piping based on the pressure represented by the pressure measurement signals and the selected flow rate to satisfy the drill pipe pressure schedule.

3. The system of claim 1, further comprising a computer-readable storage medium storing a plurality of data pairs, each data pair including a flow rate of drilling fluid through the bypass piping and a pressure in the bypass piping, wherein the plurality of data pairs include the identified one or more data pairs, and wherein the processor is further operable to: measure a plurality of flow rates of drilling fluid through the bypass piping; measure a plurality of pressures in the bypass piping, each pressure measured for a corresponding flow rate of the plurality of flow rates; and store the measured plurality of flow rates and the plurality of pressures on the computer-readable storage medium as the plurality of data pairs.

4. The system of claim 1, wherein the processor is further operable to:

identify a subset of the plurality of data pairs;

provide each flow rate of drilling fluid and each pressure in the bypass piping included in each data pair in the subset to a curve fit function;

execute the curve fit function to determine a modified drilling fluid flow rate.

5. The system of claim 1, further comprising a flow meter connected to the pressure control device to measure a flow rate at which the pressure control device releases the drilling fluid.

6. The system of claim 5, wherein the processor is further operable to: receive the flow rate measured by the flow meter connected to the pressure control device; and compare the flow rate measured by the flow meter to the selected flow rate.

7. The system of claim 1, further comprising a transmitter in electronic communication with the processor to transmit control signals to at least partially open the pressure control device to release the drilling fluid at the selected flow rate.

8. The system of claim 1, further comprising a flow meter connected to the drilling fluid pump to measure the drilling fluid flow rate through the bypass piping.

9. A computer-implemented method to regulate drilling fluid pressure, the method comprising:

receiving pressure measurement signals representative of a pressure of a drilling fluid discharged by at least one drilling fluid pump into a discharge piping at a drilling fluid flow rate, wherein the drilling fluid pump has an inlet connected to the discharge piping and has an outlet connected to bypass piping;

determining that a target pressure parameter of the drilling fluid in the discharge piping is not satisfied;

in response to determining that the target pressure parameter is not satisfied, adjust a pressure control device to modify the pressure of the drilling fluid in the discharge piping to approach the target pressure parameter by at least partially opening the pressure control device and releasing drilling fluid into a bypass piping at a selected flow rate, wherein the pressure control device is connected at an inlet to the discharge piping and at an outlet to bypass piping; and

determining the selected flow rate at which the at least partially open pressure control device releases the drilling fluid by:

identifying one or more data pairs, each data pair including a flow rate of drilling fluid through the bypass piping and a pressure in the bypass piping;

providing the flow rate of drilling fluid through the bypass piping and the pressure in the bypass piping included in each data pair of the identified one or more data pairs as an input to a curve fit function; and

executing the curve fit function to determine the selected flow rate at which the at least partially open pressure control device releases the drilling fluid; and

modifying the drilling fluid flow rate in the discharge piping based on the pressure represented by the pressure measurement signals and the selected flow rate in the bypass piping such that the target pressure parameter of the drilling fluid in the discharge piping is satisfied.

10. The method of claim 9, wherein the target pressure parameter in the discharge piping corresponds to a drilling fluid drill pipe pressure schedule according to which the drilling fluid pump discharges the drilling fluid through the discharge piping, and wherein the method further comprises modifying the drilling fluid flow rate in the discharge piping based on the pressure represented by the pressure measurement signals and the selected flow rate to satisfy the drill pipe pressure schedule.

11. The method of claim 9, further comprising: measuring a plurality of flow rates of drilling fluid through the bypass piping; measuring a plurality of pressures in the bypass piping, each pressure measured for a corresponding flow rate of the plurality of flow rates; and storing the plurality of flow rates and the plurality of pressures as a plurality of data pairs which include the identified one or more data pairs.

12. The method of claim 9, further comprising: measuring a flow rate at which the pressure relief device releases the drilling fluid; and comparing the flow rate to the selected flow rate.

13. The method of claim 9, further comprising:

identifying a subset of the plurality of data pairs;

providing each flow rate of drilling fluid and each pressure in the bypass piping included in each data pair in the subset to a curve fit function; and

executing the curve fit function to determine a modified drilling fluid flow rate.

14. The method of claim 9, further comprising transmitting control signals to at least partially open the pressure control device to release the drilling fluid at the selected flow rate.

15. The method of claim 9, further comprising measuring the drilling fluid flow rate through the bypass piping.

16. A non-transitory computer-readable medium storing instructions executable by one or more processors to perform operations comprising:

receiving pressure measurement signals representative of a pressure of a drilling fluid discharged by at least one drilling fluid pump into a discharge piping at a drilling fluid flow rate,

wherein the drilling fluid pump has an inlet connected to the discharge piping and has an outlet connected to bypass piping;

determining that a target pressure parameter of the drilling fluid in the discharge piping is not satisfied;

in response to determining that the target pressure parameter is not satisfied, adjust a pressure control device to modify the pressure of the pressure of the drilling fluid in the discharge piping to approach the target pressure parameter by at least partially opening the pressure control device and releasing drilling fluid into a bypass piping at a selected flow rate, wherein the pressure control device is connected at an inlet to the discharge piping and at an outlet to bypass piping;

determining the selected flow rate at which the at least partially open pressure control device releases the drilling fluid by:

identifying one or more data pairs, each data pair including a flow rate of drilling fluid through the bypass piping and a pressure in the bypass piping;

providing the flow rate of drilling fluid through the bypass piping and the pressure in the bypass piping included in each data pair of the identified one or more data pairs as an input to a curve fit function; and

executing the curve fit function to determine the selected flow rate at which the at least partially open pressure control device releases the drilling fluid; and modifying the drilling fluid flow rate in the discharge piping based on the pressure represented by the pressure measurement signals and the selected flow rate in the bypass piping such that the target pressure parameter of the drilling fluid in the discharge piping is satisfied.