CLAIMS:

What is claimed is:

1. A process for upgrading a hydrocarbon for a predetermined period of time, comprising:

determining a first amount of silicon material present in a hydrocarbon feed that is to be steam cracked in a steam cracker to produce a steam cracker effluent;

determining a second amount of silicon material that will be present in a steam cracker naphtha that is to be separated from the steam cracker effluent for a predetermined period of time, the second amount of silicon material being based, at least in part, on the first amount of silicon material present in the hydrocarbon feed that is to be steam cracked; and

introducing a sufficient amount of one or more catalysts into a hydroprocessing unit to allow the hydroprocessing unit to hydroprocess the steam cracker naphtha that is to be separated from the steam cracker effluent for at least as long as the predetermined period of time without requiring replacement or re-activation of the one or more catalysts due to catalyst deactivation caused by the silicon material present in the steam cracker naphtha.

2. The process of claim 1, wherein the second amount of silicon material that will be present in the steam cracker naphtha is 5% to 75% of the first amount of silicon material present in the hydrocarbon feed that is to be steam cracked.

3. The process of claim 2, wherein the second amount of silicon material that will be present in the steam cracker naphtha is 15% to 52.5% of the first amount of silicon material present in the hydrocarbon feed that is to be steam cracked.

4. The process of any one of claims 1 to 3, wherein the first amount of silicon material present in the hydrocarbon that is to be steam cracked is determined by one or more measurements using one or more of an atomic emission detector, an x-ray fluorescence spectrometer, and an inductively coupled plasma-mass spectrometer.

5. The process of any one of claims 1 to 4, wherein the silicon material in the steam cracker naphtha comprises $\leq$ 1 wt. % of C_5-C_6 silicones, 10 wt. % to 50 wt. % of C_7-C_9 silicones, and 60 wt. % to 90 wt. % of C_{10+} silicones, based on the weight of the silicon material in the steam cracker naphtha.

6. The process of any one of claims 1 to 5, wherein the silicon material that is present in the hydrocarbon feed that is to be steam cracked comprises sand, dirt, quartz, glass, lava, pumice, polysiloxanes, water soluble hydrophilic silicones, or a mixture thereof, and wherein the one or more catalysts comprises a nickel sulfide catalyst, a nickel molybdenum catalyst, a cobalt molybdenum catalyst, or a mixture thereof.

7. The process of any one of claims 1 to 6, wherein the first amount of silicon material present in the hydrocarbon feed that is to be steam cracked is 0.1 weight parts per million to 25 weight parts per million based on a weight of the hydrocarbon feed that is to be steam cracked.

8. The process of any one of claims 1 to 7,
wherein the hydroprocessing unit comprises a first hydroprocessor that includes a first catalyst disposed therein and a second hydroprocessor that includes a second catalyst disposed therein, and wherein an amount of the first catalyst that is introduced into the first hydroprocessor is less than an amount of the second catalyst that is introduced into the second hydroprocessor.

9. The process of claim 8, wherein the hydroprocessing unit comprises a first hydroprocessor that includes a first catalyst disposed therein and a second hydroprocessor that includes a second catalyst disposed therein, and wherein an amount of the first catalyst that is introduced into the first hydroprocessor is greater than an amount of the second catalyst that is introduced into the second hydroprocessor.

10. The process of claim 9, wherein the predetermined period of time is based, at least in part, on a desired volume of the hydrocarbon feed that is to be steam cracked during the predetermined period of time.

11. A process for upgrading a hydrocarbon for a predetermined period of time, comprising:

measuring a first amount of silicon material in a hydrocarbon feed that is to be steam cracked in a steam cracker to produce a steam cracker effluent;

determining a second amount of silicon material that will be present in a steam cracker naphtha that is to be separated from the steam cracker effluent based, at least in part, on the first amount of silicon material present in the hydrocarbon feed that is to be steam cracked;

introducing a sufficient amount of one or more catalysts into a hydroprocessing unit to allow the hydroprocessing unit to hydroprocess the steam cracker naphtha that is to be

separated from the steam cracker effluent for at least as long as a predetermined period of time without requiring replacement or re-activation of the one or more catalysts due to catalyst deactivation caused by the silicon material present in the steam cracker naphtha;

heating a mixture comprising the hydrocarbon feed that is to be steam cracked and water, steam, or a mixture of water and steam to produce a heated mixture comprising steam and the hydrocarbon feed that is to be steam cracked;

separating a vapor phase product and a liquid phase product from the heated mixture comprising steam and the hydrocarbon feed that is to be steam cracked;

steam cracking the vapor phase product to produce a steam cracker effluent;

separating the steam cracker naphtha and a process gas comprising ethylene and propylene from the steam cracker effluent; and

hydroprocessing the steam cracker naphtha for at least as long as the predetermined period of time.

12. The process of claim 11, wherein the one or more catalysts comprises a nickel sulfide catalyst, a nickel molybdenum catalyst, a cobalt molybdenum catalyst, or a mixture thereof.

13. The process of claim 11 or 12, wherein the second amount of silicon material that will be present in the steam cracker naphtha is 5% to 75% of the first amount of material comprising silicon present in the hydrocarbon feed that is to be steam cracked.

14. The process of any one of claims 11 to 13, wherein the second amount of silicon material that will be present in the steam cracker naphtha is 15% to 52.5% of the first amount of silicon material present in the hydrocarbon feed that is to be steam cracked.

15. The process of any one of claims 11 to 14, wherein the first amount of silicon material present in the hydrocarbon feed that is to be steam cracked is 0.1 weight parts per million to 25 weight parts per million based on a weight of the hydrocarbon feed that is to be steam cracked, and wherein the second amount of silicon material that will be present in the steam cracker naphtha is 0.015 weight parts per million to 13.125 weight parts per million.

16. The process of any one of claims 11 to 15, wherein the silicon material in the steam cracker naphtha comprises $\leq$ 1 wt. % of C_5-C_6 silicones, 10 wt. % to 50 wt. % of C_7-C_9

silicones, and 60 wt. % to 90 wt. % of C_{10+} silicones, based on the weight of the silicon material in the steam cracker naphtha.

17. The process of any one of claims 11 to 16, wherein:

the hydroprocessing unit comprises a first hydroprocessor that includes a first catalyst disposed therein and a second hydroprocessor that includes a second catalyst disposed therein,

the first hydroprocessor converts diolefins in the steam cracker naphtha to monoolefins to produce a first hydroprocessed naphtha,

the second hydroprocessor converts olefins in the first hydroprocessed naphtha to paraffins and converts sulfur compounds in the first hydroprocessed naphtha to hydrogen sulfide to produce a second hydroprocessed naphtha, and

an amount of the first catalyst that is introduced into the first hydroprocessor is less than an amount of the second catalyst that is introduced into the second hydroprocessor.

18. The process of any one of claims 11 to 17, wherein:

the hydroprocessing unit comprises a first hydroprocessor that includes a first catalyst disposed therein and a second hydroprocessor that includes a second catalyst disposed therein,

the first hydroprocessor converts diolefins in the steam cracker naphtha to monoolefins to produce a first hydroprocessed naphtha,

the second hydroprocessor converts olefins in the first hydroprocessed naphtha to paraffins and converts sulfur compounds in the first hydroprocessed naphtha to hydrogen sulfide to produce a second hydroprocessed naphtha, and

an amount of the first catalyst that is introduced into the first hydroprocessor is greater than an amount of the second catalyst that is introduced into the second hydroprocessor.

19. The process of any one of claims 11 to 18, wherein the hydrocarbon feed that is to be steam cracked comprises naphtha, gas oil, vacuum gas oil, a waxy residue, an atmospheric residue, a crude oil, or a mixture thereof.

20. The process of any one of claims 11 to 19, wherein the steam cracker naphtha comprises a mixture of C_5 to C_{10+} hydrocarbons and has an initial boiling point at atmospheric pressure of 25°C to 50°C and a final boiling point at atmospheric pressure of 220°C to 265°C, as measured according to ASTM D2887-18.

21. A system for upgrading a hydrocarbon for a predetermined period of time, comprising:

a steam cracker configured to indirectly heat a mixture comprising steam and a hydrocarbon feed to produce a heated mixture and to steam crack a vapor phase product separated from the heated mixture to produce a steam cracker effluent;

a first separator configured to separate the vapor phase product and a liquid phase product from the heated mixture;

a second separator configured to separate a steam cracker naphtha and a process gas comprising ethylene and propylene from the steam cracker effluent; and

a hydroprocessing unit comprising one or more catalysts disposed therein and configured to hydroprocess the steam cracker naphtha in the presence of the one or more catalysts and molecular hydrogen for at least as long as a predetermined period of time without requiring replacement or re-activation of the one or more catalysts due to catalyst deactivation caused by a silicon material present in the steam cracker naphtha, wherein an amount of the one or more catalysts in the hydroprocessing unit is determined according to a process comprising:

measuring a first amount of silicon material present in the hydrocarbon feed;

determining a second amount of silicon material that will be present in the steam cracker naphtha that is to be separated from the steam cracker effluent based, at least in part, on the first amount of silicon material present in the hydrocarbon feed; and

determining the amount of the one or more catalysts that should be disposed in the hydroprocessing unit based, at least in part, on the second amount of silicon material that will be present in the steam cracker naphtha that will be separated from the steam cracker effluent.

22. The system of claim 21, wherein the one or more catalysts comprises a nickel sulfide catalyst, a nickel molybdenum catalyst, a cobalt molybdenum catalyst, or a mixture thereof.

23. The system of claim 21 or 22, wherein the hydroprocessing unit comprises a first hydroprocessor comprising a first catalyst disposed therein, and a second hydroprocessor comprising a second catalyst disposed therein, wherein the first hydroprocessor is configured to convert diolefins in the steam cracker naphtha to monoolefins in the presence of molecular hydrogen and the first catalyst to produce a first hydroprocessed naphtha, and wherein the second hydroprocessor is configured to convert olefins to paraffins and sulfur compounds to

hydrogen sulfide in the first hydroprocessed naphtha in the presence of molecular hydrogen and the second catalyst to produce a second hydroprocessed naphtha .

24. The system of any one of claims 21 to 23, further comprising an atomic emission detector, an x-ray fluorescence spectrometer, inductively coupled plasma-mass spectrometer, or a combination thereof configured to measure the first amount of silicon material present in the hydrocarbon feed that is to be steam cracked.

25. A process for upgrading a hydrocarbon for a predetermined period of time, comprising:

measuring a first amount of silicon material in a hydrocarbon feed that is to be steam cracked in a steam cracker to produce a steam cracker effluent, wherein the hydrocarbon comprises naphtha, gas oil, vacuum gas oil, a waxy residue, an atmospheric residue, a crude oil, or a mixture thereof; and

determining a second amount of silicon material that will be present in a steam cracker naphtha that is to be separated from the steam cracker effluent based, at least in part, on the first amount of silicon material present in the hydrocarbon feed that is to be steam cracked.

26. The process of claim 25, further comprising:

introducing a sufficient amount of one or more first catalysts into a first hydroprocessing unit to allow the first hydroprocessing unit to hydroprocess the steam cracker naphtha that is to be separated from the steam cracker effluent for at least as long as a predetermined period of time without requiring replacement or re-activation of the one or more first catalysts due to catalyst deactivation caused by the silicon material present in the steam cracker naphtha;

introducing a sufficient amount of one or more second catalysts into a second hydroprocessing unit to allow the second hydroprocessing unit to hydroprocess a pretreated steam cracker naphtha that is to be recovered from the first hydroprocessing unit for at least as long as a predetermined period of time without requiring replacement or re-activation of the one or more second catalysts due to catalyst deactivation caused by the silicon material present in the steam cracker naphtha;

heating a mixture comprising the hydrocarbon feed that is to be steam cracked and water, steam, or a mixture of water and steam to produce a heated mixture comprising steam and the hydrocarbon feed;

separating a vapor phase product and a liquid phase product from the heated mixture comprising steam and the hydrocarbon feed;

steam cracking the vapor phase product to produce a steam cracker effluent;

separating the steam cracker naphtha and a process gas comprising ethylene and propylene from the steam cracker effluent, wherein the silicon material in the steam cracker naphtha comprises ≤ 1 wt. % of C_5-C_6 silicones, 10 wt. % to 50 wt. % of C_7-C_9 silicones, and 60 wt. % to 90 wt. % of C_{10+} silicones, based on the weight of the silicon material in the steam cracker naphtha;

hydroprocessing the steam cracker naphtha for at least as long as the predetermined period of time in the first hydroprocessing unit to produce the pretreated steam cracker naphtha; and

hydroprocessing the pretreated steam cracker naphtha for at least as long as the predetermined period of time in the second hydroprocessing unit to produce a hydroprocessed steam cracker naphtha.