CLAIMS

We claim:

1. A method for the production of air gases by the cryogenic separation of air, the method comprising the steps of:

a) compressing air to a pressure suitable for the cryogenic rectification of air to produce a compressed humid air stream, the compressed humid air stream having a first pressure P_o;

b) purifying the compressed humid air stream of water and carbon dioxide within a front end purification system to produce a dry air stream having reduced amounts of water and carbon dioxide as compared to the compressed humid air stream;

c) compressing a first portion of the dry air stream in a booster compressor to form a boosted air stream, the boosted air stream having a first boosted pressure P_{B1};

d) introducing a second portion of the dry air stream and the boosted air stream to a cold box under conditions effective to separate air to form an air gas product, wherein the air gas product is selected from the group consisting of oxygen, nitrogen, and combinations thereof;

e) withdrawing the air gas product from the cold box, the air gas product having a first product pressure P_{P1};

f) introducing the air gas product to a pipeline, wherein the pipeline is configured to transport the air gas product to a location located downstream of the pipeline, wherein the pipeline operates at a pipeline pressure P_{PL}, wherein the air gas product is introduced to the pipeline at a first delivery pressure P_{D1};

g) monitoring the pipeline pressure P_{PL} within the pipeline;

h) determining a mode of operation to operate using the pipeline pressure P_{PL} of step g), wherein the mode of operation is selected from the group consisting of variable power usage, variable liquid production, and combinations thereof,

wherein during periods of time in which the mode of operation is variable power usage, the method further comprises the step of:

i) adjusting one or more pressure set points within the cold box based on the pipeline pressure P_{PL}

wherein during periods of time in which the mode of operation is variable liquid production, the method further comprises the step of:

j) adjusting one or more pressure set points within the cold box based on the pipeline pressure P_{PL}; and

k) adjusting liquid production from the cold box based on the one or more pressure set points adjusted in step j).

2. The method as claimed in claim 1, wherein the step of determining the mode of operation further comprises providing a process controller configured to access process conditions selected from the group consisting of spot pricing data for electricity, local liquid inventories, and combinations thereof.

3. The method as claimed in claim 1, wherein the one or more pressure set points of steps i) and j) is the first product pressure P_{P1}.

4. The method as claimed in claim 1, wherein during periods of time in which the mode of operation is variable liquid production, the first boosted pressure P_{B1} is kept substantially constant during steps j) and k).

5. The method as claimed in claim 1, wherein during periods of time in which the mode of operation is variable power usage, the first boosted pressure P_{B1} is adjusted such that the difference between the first delivery pressure P_{D1} and the pipeline pressure P_{PL} is below a given threshold.

6. The method as claimed in claim 5, wherein the threshold is less than 5 psi.

7. The method as claims in claim 5, wherein the threshold is less than 3 psi.

8. The method as claimed in claim 1, wherein the cold box comprises a main heat exchanger, a system of columns having a double column composed of a lower pressure column and a higher pressure column, a condenser disposed at a bottom portion of the lower pressure column, and a liquid oxygen pump.

9. The method as claimed in claim 8, wherein the air gas product is oxygen and the pipeline is an oxygen pipeline.

10. The method as claimed in claim 9, wherein the liquid oxygen pump pressurizes liquid oxygen from the lower pressure column to the first product pressure P_{P1}.

11. The method as claimed in claim 1, wherein the first product pressure P_{P1} is adjusted based upon the monitored pipeline pressure P_{PL}.

12. The method as claimed in claim 11, wherein the first boosted pressure P_{B1} is adjusted based upon the first product pressure P_{P1}.

13. The method as claimed in claim 8, wherein the air gas product is nitrogen and the pipeline is a nitrogen pipeline.

14. A method for the production of air gases by the cryogenic separation of air, the method comprising a first mode of operation and a second mode of operation, wherein during the first mode of operation and the second mode of operation, the method comprises the steps of:

sending a purified and compressed air stream to a cold box under conditions effective for cryogenically separating the air stream to form an air gas product using a system of columns, wherein the purified and compressed air stream is at a feed pressure P_F when entering the cold box, wherein the air gas product is selected from the group consisting of oxygen, nitrogen, and combinations thereof;

withdrawing the air gas product from the cold box at a product pressure P_{PO};

delivering the air gas product at a delivery pressure P_{DO} to an air gas pipeline, wherein the air gas pipeline has a pipeline pressure P_{PL};

monitoring the pipeline pressure P_{PL};

wherein during the first mode of operation, the method further comprises the steps of:

reducing the difference between the pipeline pressure P_{PL} and the delivery pressure P_{DO};

wherein during the second mode of operation, the method further comprises the steps of:

reducing the difference between the pipeline pressure P_{PL} and the delivery pressure P_{DO}; and

adjusting liquid production from the cold box,

wherein the air gas product is oxygen, wherein the cold box comprises a main heat exchanger, a system of columns having a double column composed of a lower pressure column and a higher pressure column, a condenser disposed at a bottom portion of the lower pressure column, and a liquid oxygen pump,

wherein during both modes of operation, the method further comprises the step of providing a main air compressor upstream of the cold box,

wherein during the first mode of operation, the step of reducing the difference between the pipeline pressure P_{PL} and the delivery pressure P_{DO} further comprises the step of adjusting the operation of the liquid oxygen pump and the operation of the main air compressor, such that the product pressure P_{PO} and the feed pressure P_F are adjusted,

wherein during the second mode of operation, the step of reducing the difference between the pipeline pressure P_{PL} and delivery pressure P_{DO} further comprises the step of adjusting the operation of the liquid oxygen pump while maintaining the operation of the main air compressor substantially constant, such that the product pressure P_{PO} is adjusted while keeping the feed pressure P_F substantially constant.

15. The method as claimed in claim 14, wherein the step of reducing difference between the pipeline pressure P_{PL} and the delivery pressure P_{DO} further comprises adjusting the product pressure P_{PO}.

16. The method as claimed in claim 14, wherein the step of reducing difference between the pipeline pressure P_{PL} and the delivery pressure P_{DO} further comprises the step of adjusting the feed pressure P_F.

17. The method as claimed in claim 14, wherein the step of adjusting liquid production from the cold box further comprises the step of maintaining the feed pressure P_F substantially constant.

18. The method as claimed in claim 14, wherein the product pressure P_{PO} and the delivery pressure P_{DO} are substantially the same.

19. The method as claimed in claim 14, wherein the cold box further comprises a gaseous oxygen (GOX) feed valve, wherein the GOX feed valve is in fluid communication with an outlet of the liquid oxygen pump and an inlet of the air gas pipeline.

20. The method as claimed in claim 19, wherein the step of reducing the difference between the pipeline pressure P_{PL} and the delivery pressure P_{DO} comprises an absence of adjusting the GOX feed valve.

21. The method as claimed in claim 19, wherein the step of reducing the difference between the pipeline pressure P_{PL} and the delivery pressure P_{DO} includes maintaining the GOX feed valve fully open.

22. A method for the production of air gases by the cryogenic separation of air, the method comprising a first mode of operation and a second mode of operation, wherein during the first mode of operation and the second mode of operation, the method comprises the steps of:

sending a purified and compressed air stream to a cold box under conditions effective for cryogenically separating the air stream to form an air gas product using a system of columns, wherein the purified and compressed air stream is at a feed pressure P_F when entering the cold box, wherein the air gas product is selected from the group consisting of oxygen, nitrogen, and combinations thereof;

withdrawing the air gas product at a product pressure P_{PO};

delivering the air gas product at a delivery pressure P_{DO} to an air gas pipeline, wherein the air gas pipeline has a pipeline pressure P_{PL};

monitoring the pipeline pressure P_{PL};

wherein during the first mode of operation, the method further comprises the steps of:

reducing the difference between the pipeline pressure P_{PL} and the delivery pressure P_{DO}

wherein during the second mode of operation, the method further comprises the steps of:

reducing the difference between the pipeline pressure P_{PL} and the delivery pressure P_{DO}; and

adjusting liquid production from the cold box,

wherein the air gas product is oxygen, wherein the cold box comprises a main heat exchanger, a system of columns having a double column composed of a lower pressure column and a higher pressure column, a condenser disposed at a bottom portion of the lower pressure column, and a liquid oxygen pump,

wherein in both modes of operation, the method further comprises the step of providing a booster compressor downstream of a main air compressor and upstream of the cold box,

wherein during the first mode of operation, the step of reducing difference between the pipeline pressure P_{PL} and the delivery pressure P_{DO} further comprises the step of adjusting the operation of the liquid oxygen pump and the operation of the booster compressor, such that the product pressure P_{PO} and the feed pressure P_F are adjusted,

wherein during the second mode of operation, the step of reducing the difference between the pipeline pressure P_{PL} and the delivery pressure P_{DO} further comprises the step of adjusting the operation of the liquid oxygen pump while maintaining the operation of the booster compressor substantially constant, such that the product pressure P_{PO} is adjusted while keeping the feed pressure P_F substantially constant.