CLAIMS:

1. An elution system comprising:

a $^{82}Sr/^{82}Rb$ generator configured to generate ^{82}Rb via elution with an eluant;

an eluant line configured to supply the eluant to the $^{82}Sr/^{82}Rb$ generator;

an eluate line configured to receive eluate eluted from the $^{82}Sr/^{82}Rb$ generator and convey the eluate to at least one of a patient line and a waste line;

a gamma ray detector positioned adjacent to the eluate line and configured to detect gamma rays emitted from eluate flowing through the eluate line; and

a controller communicatively coupled to the gamma ray detector and configured to receive data indicative of the gamma radiation emitted by the eluate flowing through the eluate line, determine an activity of ^{82}Rb in the eluate based on the received data, and determine an activity of ^{82}Sr based on the received data.

2. The system of the preceding claim, wherein the controller is configured to determine the activity of the ^{82}Rb based on the received data by at least:

generating a gamma ray spectrum from the received data;

determining a net peak integral count in a region of interest associated with a 776 keV line of the gamma ray spectrum so as to establish an activity of ^{82}Rb at the 776 keV line;

determining an activity of ^{82}Rb at a 511 keV line of the gamma ray spectrum by multiplying the activity of ^{82}Rb at the 776 keV line by a branching intensity factor; and

summing the determined activity of ^{82}Rb at the 776 keV line and the determined activity of ^{82}Rb at a 511 keV line.

3. The system of claim 2, wherein determining the net peak integral count associated with a 776 keV line comprises dividing the net peak integral count associated with a 776 keV line by an efficiency factor for the 776 keV line.

4. The system of claim 3, wherein the efficiency factor for the 776 keV line comprises a ratio of activity measured at the 774 keV line by the detector for a sample of ^{134}Cs divided by a known activity for the sample of ^{134}Cs.

5. The system of claim 2, wherein the controller is configured to determine the activity of the ^{82}Sr based on the received data by at least:

determining a net peak integral count in a region of interest associated with a 511 keV line and a 514 keV line of the gamma ray spectrum;

subtracting the determined activity of ^{82}Rb at a 511 keV line from the determined net peak integral count associated with the 511 keV line and the 514 keV line so as to establish an activity of ^{85}Sr at the 514 keV line; and

multiplying the established activity of ^{85}Sr by a ratio relating an activity of ^{82}Sr to the activity of ^{85}Sr.

6. The system of claim 5, wherein determining the net peak integral count associated with the 511 keV line and the 514 keV line comprises dividing the net peak integral count associated with the 511 keV line and the 514 keV line by an efficiency factor for the 511 keV line and the 514 keV line.

7. The system of claim 6, wherein the efficiency factor for 511 keV line and the 514 keV line comprises a ratio of activity measured at the 511 keV line and the 514 keV line by the detector for a sample of ^{22}Na divided by a known activity for the sample of ^{22}Na.

8. The system of any of the preceding claims, wherein the controller is further configured to determine an activity of ^{131}Cs in the eluate based on the received data.

9. The system of claim 8, wherein the controller is configured to determine the activity of the ^{131}Cs based on the received data by at least determining a net peak integral count in a region of interest associated with a 32 keV line of the gamma ray spectrum.

10. The system of claim 9, wherein determining the net peak integral count associated with the 32 keV line comprises dividing the net peak integral count associated with the 32 keV line by an efficiency factor the 32 keV line.

11. The system of any of the preceding claims, further comprising a pump configured to pump the eluant through the $^{82}Sr/^{82}Rb$ generator, and a diverter valve configured to direct the eluate to either the patient line or the waste line.

12. The system of claim 11, wherein the controller controls the pump so as to pump eluant through the $^{82}Sr/^{82}Rb$ generator at a rate ranging from 25 ml/min to 75 ml/min such that the gamma ray detector detects gamma rays emitted from eluate flowing at a rate ranging from 25 ml/min to 75 ml/min.

13. The system of any of the preceding claims, wherein the controller is further configured to determine a cumulative activity of ^{82}Rb during a patient dosing procedure.

14. The system of claim 13, wherein the controller is further configured to compare the cumulative activity of ^{82}Rb to a threshold stored in memory.

15. The system of claim 14, wherein the threshold includes a threshold of 2220 MBq (60 mCi) and, when the controller determines that the cumulative activity exceeds 2220 MBq, the controller controls the system to cease delivering eluate to a patient.

16. The system of any of the preceding claims, wherein the controller is further configured to compare the determined activity of ^{82}Sr and a determined activity of ^{85}Sr to a threshold stored in memory.

17. The system of claim 16, wherein the threshold comprises a ^{82}Sr threshold of 0.02 μCi / mCi of ^{82}Rb and a ^{85}Sr threshold of 0.2 μCi / mCi of ^{82}Rb and, when the controller determines that either the determined activity of ^{82}Sr or the determined activity of ^{85}Sr

exceeds a corresponding threshold, the controller controls the system to cease delivering eluate to a patient.

18. The system of any of the preceding claims, wherein the gamma ray detector comprises a cadmium-zinc-telluride semiconductor detector.

19. A method comprising:

receiving data indicative of nuclear radiation emitted by an eluate eluted from a rubidium isotope generator;

determining an activity of ^{82}Rb in the eluate based on the received data in substantially real time with receipt of the data; and

determine an activity of ^{82}Sr in the eluate based on the received data in substantially real time with receipt of the data.

20. The method of claim 19, wherein receiving the data comprises detecting gamma ray radiation from eluate flowing through a line via a gamma ray detector, and determining the activity of the ^{82}Rb and the activity of ^{82}Sr in the eluate in substantially real time comprises determining the activity of the ^{82}Rb and the activity of ^{82}Sr less than 10 seconds after detecting the gamma ray radiation.

21. The method of either of claim 19 or 20, wherein determining the activity of the ^{82}Rb comprises:

generating a gamma ray spectrum from the received data;

determining a net peak integral count in a region of interest associated with a 776 keV line of the gamma ray spectrum so as to establish an activity of ^{82}Rb at the 776 keV line;

determining an activity of ^{82}Rb at a 511 keV line of the gamma ray spectrum by multiplying the activity of ^{82}Rb at the 776 keV line by a branching intensity factor; and

summing the determined activity of ^{82}Rb at the 776 keV line and the determined activity of ^{82}Rb at a 511 keV line.

22. The method of any one of claims 19–21, wherein determining the activity of the ^{82}Sr comprises:

determining a net peak integral count in a region of interest associated with a 511 keV line and a 514 keV line of the gamma ray spectrum; and

subtracting the determined activity of ^{82}Rb at a 511 keV line from the determined net peak integral count associated with the 511 keV line and the 514 keV line so as to establish an activity of ^{85}Sr at the 514 keV line; and

multiplying the established activity of ^{85}Sr by a ratio relating an activity of ^{82}Sr to the activity of ^{85}Sr.

23. The method of claim 22, further comprising dividing the net peak integral count associated with a 776 keV line by an efficiency factor for the 776 keV line and dividing the net peak integral count associated with the 511 keV line and the 514 keV line by an efficiency factor for the 511 keV line and the 514 keV line.

24. The method of any one of claims 19–23, further comprising determining an activity of ^{131}Cs in the eluate based on the received data in substantially real time with receipt of the data.

25. The method of any one of claims 19–24, further comprising controlling a flow of eluate from the rubidium isotope generator based on one of the determined activity of ^{82}Rb and the determined activity of ^{82}Sr.

26. The method of claim 25, wherein controlling the flow of eluate comprises one of diverting the eluate to a waste bottle or terminating generation of eluate if either the determined activity of ^{82}Rb or the determined activity of ^{82}Sr exceeds a threshold.

27. A calibration method comprising:

detecting gamma radiation via a gamma ray detector from a first isotope having a known activity and emitting in a region of a 776 keV line of a gamma ray spectrum;

determining an efficiency factor for the 776 keV line by dividing a detected activity of the first isotope in the region of the 776 keV line by the known activity for the first isotope;

detecting gamma radiation via the gamma ray detector from a second isotope having a known activity and emitting in a region of a 511 keV line and a 514 keV line of the gamma ray spectrum;

determining an efficiency factor for the 511 keV line and the 514 keV line of the gamma ray spectrum by dividing a detected activity of the second isotope in the region of the 511 keV line and the 514 keV line by the known activity for the second isotope; and

storing the determined efficiency factor for the 776 keV line and the determined efficiency factor for the 511 keV line and the 514 keV in a memory associated with the gamma ray detector.

28. The method of claim 27, wherein the first isotope is ^{134}Cs and the second isotope is ^{22}Na.

29. The method of either of claim 27 or 28, wherein determining the efficiency factor for the 776 keV line comprises determining a net peak integral count in a region of interest associated with a 776 keV line of the gamma ray spectrum to determine the detected activity of the first isotope, and determining the efficiency factor for the 511 keV line and the 514 keV line comprises determining a net peak integral count in a region of interest associated with a 511 keV line and a 514 keV line of the gamma ray spectrum to determine the detected activity of the second isotope.

30. The method of any one of claims 27–29 further comprising:

detecting gamma radiation via the gamma ray detector from a third isotope having a known activity and emitting in a region of a 32 keV line of the gamma ray spectrum;

determining an efficiency factor for the 32 keV line by dividing a detected activity of the third isotope in the region of the 32 keV line by the known activity for the third isotope; and

storing the determined efficiency factor for the 32 keV line in the memory associated with the gamma ray detector.

31. The method of claim 30, wherein the third isotope comprises ^{22}Na.

32. The method of claim 30 or 31, wherein determining the efficiency factor for the 32 keV line comprises determining a net peak integral count in a region of interest associated with a 32 keV line of the gamma ray spectrum to determine the detected activity of the third isotope.

33. The method of any one of claims 27–32, further comprising sequentially passing the first isotope and the second isotope past the gamma ray detector at a rate ranging from 25 ml/min to 75 ml/min.

34. The method of any one of claims 27–33, wherein the gamma ray detector comprises a cadmium-zinc-telluride semiconductor detector.

35. An elution system comprising:

a radioisotope generator configured to release a daughter radioisotope during elution with an eluant thereby producing an eluate containing the daughter radioisotope, the daughter radioisotope being produced from radioactive decay of a parent radioisotope contained within the radioisotope generator, wherein the radioisotope generator comprises one of a $^{99}Mo/^{99m}Tc$ generator, a $^{68}Ge/^{68}Ga$ generator, and a $^{82}Sr/^{82}Rb$ generator;

an eluant line configured to supply the eluant to the radioisotope generator;

an eluate line configured to receive and convey eluate eluted from the radioisotope generator;

a gamma ray detector positioned to detect gamma rays emitted from radioisotopes released by the radioisotope generator, and decay products thereof, and conveyed from the radioisotope generator via the eluate line; and

a controller communicatively coupled to the gamma ray detector and configured to receive data indicative of the gamma radiation emitted by the radioisotopes released by the

radioisotope generator and the decay products thereof, determine an activity of the daughter radioisotope in the eluate based on the received data, and determine an activity of the parent radioisotope in the eluate based on the received data.

36. The system of claim 35, further comprising an accumulator structure positioned downstream from the radioisotope generator and in fluid communication with the eluate line, the accumulator structure being configured to capture a larger amount of parent radioisotope than daughter radioisotope.

37. The system of claim 36, wherein the radioisotope generator comprises a generator column loaded with the parent radioisotope and the accumulator structure comprises a second column devoid of the parent radioisotope.

38. The system of claim 36 or 37, wherein the radioisotope generator comprises a $^{68}Ge/^{68}Ga$ generator, the daughter radioisotope is ^{68}Ga, the parent radioisotope is ^{68}Ge, and the controller is configured to determine the activity of ^{68}Ga in the eluate and determine the activity of ^{68}Ge in the eluate by at least:

generating a first gamma ray spectrum from data received from the gamma ray detector representing gamma radiation emitted from eluate flowing past the gamma ray detector;

determining a net peak integral count over a 511 keV line of the gamma ray spectrum to establish the activity of ^{68}Ga in the eluate;

generating a second gamma ray spectrum from data received from the gamma ray detector representing gamma radiation emitted from ^{68}Ga decayed from ^{68}Ge captured on the accumulator structure;

determining a net peak integral count over the 511 keV line of the gamma ray spectrum to establish the activity of ^{68}Ga decayed from ^{68}Ge captured on the accumulator structure; and

adjusting the established activity of ^{68}Ga decayed from ^{68}Ge to determine the activity of ^{68}Ge in the eluate.

39. The system of any one of claims 35–38, wherein the controller is configured to determine the activity of the daughter radioisotope and determine the activity of the parent radioisotope based on the received data by at least:

generating a gamma ray spectrum from the received data;

determining a net peak integral count over a portion of the gamma ray spectrum in which the daughter radioisotope emits, thereby establishing an activity of the daughter radioisotope; and

determining a net peak integral count over a portion of the gamma ray spectrum in which the parent radioisotope emits, thereby establishing an activity of the parent radioisotope.

40. The system of any one of claims 35–39, further comprising a base frame with wheels, wherein the radioisotope generator, eluant line, eluate line, gamma ray detector, and controller are mounted on the base frame so as to be movable.

41. The system of any one of claims 35–40, wherein the controller is further configured to control a flow of eluate from the radioisotope generator based on one of the determined activity of the daughter isotope and the parent isotope.

42. The system of claim 41, wherein the controller is configured to control the flow of eluate by one of diverting the flow of eluate to a waste bottle or terminating generation of eluate, if either the determined activity of the daughter isotope or the determined activity of the parent isotope exceeds a threshold.