As you complete this scientific investigation, fill in any needed information on the report template. If you need more information about each section of the report, please visit the Developmental Module.

**Title**

Nuclear Processes Scientific Investigation

**Hypothesis**

Using the three **Procedure and Data Collection** sections below, read through the procedural information for this scientific investigation. Based on your understanding of the procedure, develop your own hypotheses to verify Conservation of Mass and Energy in Nuclear Reactions. Use the guide questions below as your data/data analysis sections. Utilize actual cost analysis (cite your sources) to determine the most effective and efficient method for production of electrical energy. Record these hypotheses below:

**Data Collection and Analysis**

**Alpha Decay Simulation Procedure and Data Collection**

1. Observe the decay of Polonium-211. Write a nuclear equation representing the decay of Po-211.
2. What happens within the nucleus of Po-211 during decay?
3. The half-life of Po-211 is approximately 500 ms or half a second. Below provide the number of undecayed Po-211 atoms at each time interval for a reaction starting with 100 total atoms.
   1. t=0.5s
   2. t=1.0s
   3. t=1.5s
   4. t=2s
4. Compare your predictions in question 3. How would you explain any discrepancies?

**Beta Decay Simulation Procedure and Data Collection**

1. Write nuclear equations for the decay processes you just observed.
2. Where does the beta particle come from in beta decay? What other particle is produced during the decay process?

**Nuclear Fission Simulation Procedure and Data Collection**

1. Briefly describe how Uranium-235 can be made unstable. Write a nuclear equation to represent this process.
2. What do you think would be the effect of firing a neutron into one of 100 atoms of Uranium-235?
3. Did the results validate your prediction? Explain.
4. Based on observations in this simulation, what are the criteria and settings needed to create and atomic bomb?
5. Why do you think that "weapons-grade" Uranium would not contain very much Uranium-238?
6. What purpose do the control rods serve? Why are they important?

**Conclusion**

Compose three to four sentences describing an overall conclusion about nuclear decay and how it can be harnessed for specific purposes. Were your hypotheses true or false, and how do you know? Use the data and notes that you collected from your simulation experiences to form your conclusion. Make sure that you include information that you gained from data analysis to support your conclusion.

**Experimental Sources of Error**

On your Nuclear Processes Scientific Investigation Report, provide responses to the following questions: **Are there any sources of error? If so, what are they and what could be done to minimize error?**