Ideas for ERT

1. There is an excellent opportunity in ERT as written work or PowerPoint by comparing Fukushima Daiichi problem to Chernobyl because the nature of the problems were fundamentally different.  The first presents an opportunity to talk about decay chains in a rich context, and the second about the physics that should have been considered at the time of designing the plant.  Offers a chance to go A level in KCU, IP and EC without having to add bells and whistles.
2. Powering the grid:  
   Nuclear activity provides lots of heat, but this is only one step in the supply of electrical energy. You could draw in what you have learned about electromagnetism, Faraday’s law, transformers, generators, alternators and so forth to explain the conversion of nuclear energy into electricity, and then on to the electricity grid.
3. Harnessing the ghost without sunburn:  
   It is well known that nuclear materials are potentially hazardous. But how hazardous? What are the forms of measurement used to quantify exposure? What are the differences between the different kinds of nuclear radiation as far as human health is concerned? What in the blue blazers is a rad, and if I have a million of them, should I be happy, or concerned? It would be expected that the equipment used to measure radiation be considered, and that formulas be used to quantify hazard and risk. Methods of protection and recommendations are a natural part of this study.
4. Harnessing the ghost with possible sunburn:  
   While in everyday life excess radiation is a hazard, there are some diseases that are readily treatable using radiation. But which form of radiation is preferable, and why this as opposed to others. Explain the relevant physics. How does this kind of exposure work, and how does it help? What are the side effects if any (remembering that this is a physics, not biology assignment)? How do the medical bods measure exposure? How does the dosage reduce with distance and depth of penetration? What are the formula’s used by the medical physicist? What are they doing with the equipment used at the cutting edge of technology and how does this reduce dangers and side effect, if at all?
5. The Chernobyl disaster – 25 years on: Wikipedia says...  
   On April 26, 1986, reactor number four at the Chernobyl plant, near Prypiať in the Ukrainian Soviet Socialist Republic, had a meltdown. The resulting fire sent a plume of radioactive fallout into the atmosphere and over an extensive geographical area, including the nearby town of Pripyat. Four hundred times more fallout was released than had been by the atomic bombing of Hiroshima.[dubious – discuss][2] The plume drifted over large parts of the western Soviet Union, Eastern Europe, Western Europe, and Northern Europe. Large areas in Ukraine, Belarus, and Russia had to be evacuated, with over 336,000 people resettled. According to official post-Soviet data,[3] about 60% of the fallout landed in Belarus.  
   The accident raised concerns about the safety of the Soviet nuclear power industry as well as nuclear power in general, slowing its expansion for a number of years while forcing the Soviet government to become less secretive.  
     
   In seeking to deal with the disaster the USSR sent in bio-robots – people – to try to contain the crisis. It is said that they used people because real robots were rapidly destroyed by the radiation. It is said that this disaster brought an end to the Soviet Union, achieving in a single event that which Western governments had sought to do since 1917.  
   You could investigate the long term effects of radiation on these bio-robots, or the people of the district, or the surrounding wildlife. Of course the pictures will be stunning and gut-wrenching, but do not allow this to distract you from quantifying the radiation hazard using the language of physics, and its formulas. Use these to provide a singular perspective on the nature of the disaster, and your opinion of its initial, short term or long term impact. There are likely many other aspects deserving of attention. Your challenge will be to pick out a topic that is highly focussed and arguments that can be properly put in a short presentation.
6. Chernobyl – a good idea at the time, but...  
   There are different kinds of nuclear reactors. Each has its strengths and weaknesses. You could do a comparative analysis of these and consider any that are on the drawing board at present. Which is safest? Which is cheapest? This presentation would at least cover the basics of controlled nuclear reaction, and describe not only the components of a operating plant – control rods, fuel rods, and the way in which these interact in an actual plant – but will consider critical distances and the potential hazards. This ought to be more than a mere gloss over how these work. You could do a detailed analysis of one type and coordinate with another student studying another kind of reactor to compete for which is the ‘best’ option or ‘worst’ option.
7. To infinity and beyond:  
   Out in space, the use of radiation as a power source or investigative tool is of less concern that it is on our little, mostly blue, planet. Especially so given the masses of radiation and cosmic rays that are already there as a result of the action of the sun, and massive events believed to occur in deep space (exactly because of the existence of cosmic rays). Several opportunities present. You might investigate the quantities and type of radioactive material used in spaceships, and quantify the energy they provide, as well as the period over which this energy is provided, and might compare this to what would otherwise need to be sent out into space to achieve the same result, if indeed other options are realistic. You could compare this to using solar energy, and the effect of moving further away from Sol.  
   You might also consider the effect of a disaster on the launch pad. Quantify the hazard using known equations, and investigate NASA’s likely response. Remember that this is a physics assignment, not just an exercise in disaster management.
8. A nuclear winter:  
   During the Cold War a prime area of concern was that it might heat up. At the time of the Cuban missile crisis there was a very definite probability of nuclear proliferation, in which the USSR and USA would slug it out with nuclear missiles. For a time there were enough nuclear missiles ready to go that the entire would could be killed many times over, and only bugs in the Deep Ocean, and cockroaches would survive. This would have been followed by an extended nuclear winter. But that is that and what is the cause, from a physics perspective?  
   With the passage of time many of these missiles have been decommissioned. In reality the warhead have fairly limited lifespan due to decay. Why is this? You could investigate the viability of a ten year old missile using known equations and provide a report to class on available options.
9. Having your yellow cake and eating it too:  
   Nuclear material such as Uranium 235 is only useful in a nuclear power plant when the concentration is above a certain level. Kilo for kilo, nuclear material is expensive. What options might the owner of a power plant use to deal with spent material? Why is Uranium 235 the best option? Could other nuclear materials be used? What are the advantages and disadvantages of Uranium 235 as opposed to Uranium 238 or other isotopes? It would be expected that you would use known equations and physical principles to explain your choices.
10. Tokomak...that’s a cream for a rash isn’t it?  
    The attempt to extract energy from nuclear fusion is a dream for mankind because it could power the world with hydrogen extracted from water. The magic energy bullet. But it ain’t so easy. Why? Tokomak was the first fusion reactor built, and has come ahead in leaps and bounds. But is it enough? Your task would be to investigate how this works, drawing you recently gained knowledge of electromagnetism (including equations). The pictures will be fabulous of course, but you will not allow this to distract you from the hard science. You will need to analyse and evaluate Tokomak or its siblings and provide a well reasoned assessment.
11. Our mate, Sol:  
    There is more to the sun than meets the eye. Where do the nuclear processes actually occur? You might draw in some astronomy and consider the protosun and the origin of the Solar System. Of course, the pictures will be fabulous, however, in the end you need to investigate the physics of fusion and draw in ideas of convection. You might also draw in electromagnetism as this relates to solar flares, and answer the question – what is the Solar Wind?
12. Carbon dating – that’s like RSVP isn’t it:  
    Using the rate of decay of Carbon 14 atoms is a useful tool, but some say it is as much art as science. Why might this be? Of course the pictures of old guys dragged out of bogs (meaning stone age men dragged out of peat bogs, not Brother Mick ... you get the idea) will be fabulous, but will not detract from the hard edge of the presentation that includes equations, scientific assumptions, and limitations of the model.
13. There are many, many topics that might be explored. Nuclear decay was discovered by an act of serendipity, and has gone on to be at the centre of political intrigue and even a nasty, sad, tragic, political assassination.