

To be opened on receipt**GCSE TWENTY FIRST CENTURY SCIENCE
PHYSICS A****A333/02** Unit 3: Ideas in Context plus P7 (Higher Tier)**RESOURCE BOOKLET****JANUARY 2013****INSTRUCTIONS TO CANDIDATES**

- This booklet contains the article required to answer question 1.
- Take this article away and read it through carefully.
- Spend some time looking up any technical terms or phrases you do not understand.
- For the examination on **Thursday 24 January 2013** you will be given a fresh copy of this article, together with a question paper.
- You will **not** be able to take your original copy into the examination with you.

INFORMATION FOR CANDIDATES

- This document consists of **4** pages. Any blank pages are indicated.

Nuclear waste: bury it and forget?

SELLAFIELD – It is the regular beeping that grates. But if it stops, prepare to be scared.

The signal, audible every second in every corridor of the high-level toxic nuclear waste plant on the sprawling Sellafield site, is a sign that all the alarms are working. If it stops, or changes tone, something has gone very wrong.

The alarms are crucial for an industry that believes it could be granted a new lease of life, as the world searches for an alternative to fossil fuels such as coal and oil. These fossil fuels produce carbon emissions, which have been blamed for global warming.

The nuclear industry says its technology emits no carbon and does not cause global warming. But for many, still wary after disasters like the 2011 tsunami at Fukushima, the lingering fear is that the chemically toxic waste might leak and kill.

HELL'S BREW

Waste sludge flows down the heavily armoured pipe into Sellafield's vitrification plant after plutonium and uranium have been taken from spent fuel rods for reuse. This hell's brew still emits 40 times the lethal dose of radiation.

In shielded chambers, with technicians watching through metre-thick leaded glass windows and using remote mechanical arms, the toxic stew is cooked down to a powder, combined with molten glass and then poured into stainless steel urns.

The urns are cooled, closed and scrubbed before being sealed in insulated steel flasks. They are taken away for storage where, standing 10 deep in a concrete core and capped by a three-metre plug, the heat from the radiation can still be felt.

LETHAL LEGACY

Final disposal of the waste involves burying it in geologically stable formations. The half-life of plutonium-239 is 24 000 years – in other words, it would take up to 250 000 years before it degrades completely.

Scientists have suggested disposing of high-level waste by sending it into space and into the Sun or putting it in deep ocean trenches where it will be subducted into the mantle. But these methods have been dismissed as too risky.

It is not just the high-level waste from fuel rods that has to be dealt with. Intermediate-level waste such as the casings of nuclear fuel rods and low-level waste such as that produced in hospitals also have to be processed and stored.

Intermediate-level waste is chopped up and put in steel barrels that are filled with concrete and stored. Low-level waste is put in steel boxes that are crushed and put in a container, which is then filled with concrete and buried.

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