Geomagnetic storms and pipelines

A VICTORIA SCIENCE TEACHING RESOURCE

WHO?

A team of researchers, including Dr Malcolm Ingham from Victoria University of Wellington and Professor Craig Rodger from the University of Otago are looking at how to protect our electrical systems from a geomagnetic storm.

WHAT WAS THE PROBLEM?

There was a major fuel crisis when a pipeline in Northland developed a major leak after being damaged by a digger.

WHAT ARE THEY SAYING?

Geomagnetic storms caused by solar flares may have caused the pipe to become corroded after being damaged by a digger and eventually breaking open.

WHAT'S A GEOMAGNETIC STORM?

The Sun is constantly producing a stream of charged particles that travel outwards into space. Every now and then, there is a particularly large burst of these called a 'solar flare'. When these bursts of charged particles reach the Earth they are often seen in the form of auroras.

If solar flares were to hit the Earth directly they would cause a lot of harm.. Fortunately the Earth's magnetic field protects us from the worst of these bursts. However, the more powerful solar flares can create what's called a 'geomagnetic storm'. During a geomagnetic storm, there is a rapid change in Earth's magnetic field, which can create problems for our electrical grid, satellite systems, and other important pieces of infrastructure.

USING YOUR UNDERSTANDING OF PHYSICS PRINCIPLES, INVESTIGATE THESE QUESTIONS.

- How could a geomagnetic storm affect our electrical grid?
- How could it affect gas pipelines?

Inductive Reasoning

WHAT'S THE PROBLEM?

The changing magnetic field is inducing currents in the pipelines. This can cause pipelines to become positively charged relative to the ground, which speeds up the rate that the metal corrodes. Ordinarily, these pipes would be surrounded in an insulating cladding that protects them from this. In the case of the Northland pipeline, the cladding was damaged at some point in the past and over time this exposed area may have corroded at a much faster rate.

SOLUTIONS

- How do engineers normally protect pipelines from the effects of geomagnetic storms?
- What are some other strategies you could suggest?

A SUN-SIZED PROBLEM

Dr Ingham and Professor Rodger are investigating how particularly intense solar storms might affect our power-grid. These storms aren't common, but could potentially have a catastrophic effect on our increasingly technological world. In 1989 a massive solar flare knocked out electricity for the entire province of Quebec and parts of North America. In 1859, a solar storm called the 'Carrington Event' was so powerful that telegraph operators could unplug their equipment and still send messages using the electricity generated by the storm.

HOW CAN WE PREPARE?

Using an understanding of physics principles, investigate these questions.

In the event of a massive geomagnetic storm, which pieces of technology would get affected the worst? Look at:

- Personal electronics.
- Home appliances.
- National electrical infrastructure.
- Public services – health, fire, water.
- Communications networks

How could we protect ourselves from the impacts of these storms?