Anglesey’s spectacular coastal scenery hides a secret. Nestled on the top of a cliff just behind Wylfa Head lies one of Britain’s oldest nuclear power stations. But the Wylfa A plant’s days are numbered as the government has earmarked the 1971 plant for replacement, and work is already under way on the ground investigation for the new development.

The power station lies on the coast next to the popular tourist village of Cemaes Bay, but despite its location the plans for a new plant – one of eight sites listed in the government’s National Policy Statement – are well supported. As you approach Wylfa you get a real sense of the scale of the power station infrastructure and the number of local people employed in its operation, as well as its importance in the local economy.

Plans for the new 3,000MW nuclear plant at Wylfa were unveiled in 2009 by Horizon Nuclear Power – a joint venture between E.on and RWE. Site investigation began soon after and is only now nearing completion, underlining the complexity of work needed for a development of this type.

The investigation started in October 2009 when RSK Group’s site investigation contracting arm Structural Soils was commissioned to undertake a preliminary ground investigation and later also won the contract for the intermediate phase ground investigation.

Horizon accepted Structural Soils’ bid for the intermediate work in February this year. Although the contract period was initially for 15 weeks, the findings were reviewed during the investigation and additional work was specified, so the contract period was extended by four weeks.

Scope of work
The scope of work was wide-ranging, with geophysics, cable percussion, rotary drilling, trial pitting, trial trenching, insitu permeability testing and a field vibration trial planned. Most of the work was carried out on part of the 250ha nominated site, currently used as farm land, where Horizon plans to build its new reactors.

Structural Soils had recently completed the ground investigation work for the new nuclear reactor at Hinkley Point and was able to quickly mobilise its experienced engineers to Wylfa.

“It was a constant challenge to ensure that all the ground investigation components were completed on time and were adaptive to the unique nature of the site,” says Structural Soils project manager Adrian Barby-Moule. “We were fortunate that the majority of the site works were carried out during an unseasonably dry period. Boggy ground, high winds and torrential rain that are normally common on Anglesey just did not happen.

“It was still a demanding contract because there were many different elements involved. The key was to keep everything moving and to adapt the planning on an hour-by-hour basis so that nothing on the
programme slipped back to impact on the work still to be done.”

After establishing water supplies and 3km of temporary access roads, the first task was carry out trials at the site to find the most effective geophysics techniques for the scheme. Seismic refraction, resistivity, and ground penetrating radar were used to obtain the bedrock depth and profile. The result of the trial was the progression of the resistivity and seismic refraction surveys on a grid pattern across the site, which culminated in 10km of both techniques being carried out.

A seismic reflection trial made up the last element of the initial geophysical work and, based on the results, Horizon was keen to progress this technique. Another 3.5km of survey was carried out with 1,800 boreholes drilled up to 2m deep, 2m apart that were charged with 100g of high explosive, stemmed and detonated in sections, depending where the monitoring array was set out.

On site challenges

With geophysics under way, the intrusive investigation started with cable percussion, followed by rotary coring, so that at the peak of the site work there were 13 drilling rigs operating. Rotary coring was carried out using a diamond impregnated bit with both water and air mist flush. In total there were 31 vertical boreholes up to 100m depth.

Once the results from the reflection, refraction and resistivity surveys were available, the positions of the inclined boreholes were then planned to intersect potential fault zones. “This gave us a challenge as there is only a limited number of drilling rigs that can drill inclined boreholes up to 100m, and all the vertical boreholes were already completed,” says Structural Soils site drilling manager James Wickenden.

In total, 22 boreholes were drilled at an angle of 55 degrees from the horizontal. Logging of more than 3.9km of cores, which included highly altered and deformed metamorphic deposits, was carried out on site.

Permeability testing was carried out on some of the vertical boreholes using packer tests with low flow meters that could measure permeabilities of less than 10-8m/s.

This information helped to build up a picture of the hydrological conditions on site that will be required for the detailed design of the plant. Some boreholes had piezometers installed in them, while others had a plastic liner installed for downhole seismic testing by the RSK geophysical team.

One of the objectives of the investigation is to study the faults that were picked up from a previous investigation in the late 1980s. As part of a seismic hazard assessment, project consultant Arup needed to actually see the evidence, and Horizon requested that a number of observation pits be dug across the site.

Initially Structural Soils had planned to use trench boxes to stabilise the overlying glacial deposits so that a detailed inspection of the bedrock could be made. “The first trench went in well and everything was looking good,” says Structural Soils engineer Will Allwood. “There was quite a lot of focus on this activity from a health and safety perspective.”

But after shoring one of the trenches to 4m depth for safety, it was impossible to view the sidewalls that were important in the logging of the potential faults. “The trench boxes were also cumbersome to move around,” says Allwood. The trench boxes were therefore abandoned in favour of an open pitting exercise.

The result was gigantic trial pits measuring up to 30m long by 9m wide with angled side walls to ensure safety. These meant that the sidewalls could now be logged in their entirety to pick up any glaicio-tectonic features that may be present. In total 21 observation trenches were dug.

Excavation challenge

The demands of excavation during the construction phase were also considered, with estimates suggesting that 1M.m³ of soil and 1.5M.m³ of rock will need to be excavated on the site. While the soil should not present a problem, Horizon wanted to investigate the potential to use explosives to excavate the rock.

Two areas were selected for field vibration trials (FVTs) and a workshop was set up with the stakeholders to establish which sensitive structures needed monitoring. Seismographs were then set up to measure peak particle velocity and acceleration (PPV and PPA) at 12 locations around each test area.

On each FVT there were seven monitoring positions set out in an array away from the source over two arms at right angles. The source holes were 100mm diameter and sunk to 6m below rockhead. These were charged with increasing weights of explosives between 0.5kg and 3kg and detonated sequentially. After each detonation all the monitoring positions were checked to ensure the prescribed PPV and PPA levels were not surpassed, but all were below the threshold levels.

Structural Soils finished site work on schedule in early July and is now in the process of finalising the factual report, having carried out extensive laboratory testing.

“This has been a challenging contract to manage due to the diversity of techniques used and the tight timescales,” says Barby-Moule. He is not only pleased that the team managed to drill and log 3.9km of rock on site, but he also believes that the level of co-operation between all parties – client, consultant and contractor – helped overcome the project’s challenges. “Everyone was moving forward in one direction, with the same focus,” he says.