A history of ELGAS

R. E. Ringer

embedded into the sandstone to a depth of one metre, and grouted to make a watertight seal. This ensured that saline water in the reclaimed land would not infiltrate the aquifer in the sandstone below. Only when the diaphragms were keyed into the bedrock, could removal of the sand within the foreshaft structures proceed as planned. Once more, the grab and bucket excavator was used to scoop out thousands of tonnes of sand and dirt.

As for the shafts themselves, the operations shaft measured 4 metres wide. It would ventilate the working areas as well as serve as an emergency escape route during construction. Connecting the surface to the Cavern roof, it extended below the Cavern into a pump sump. Operation pipes and equipment were installed in the shaft and anchored in a sealing concrete plug located immediately above the Cavern crown. Meanwhile, the 6-metre wide access shaft would act as the main access and exit point for people and materials.

In May 1996 a start was made on building above-ground reinforced concrete structures[5] over the shafts. These would allow for the erection of the shaft headframe and related equipment necessary for both shafts, a process which was completed by October 1996. As Warring Neilsen wrote as the time:

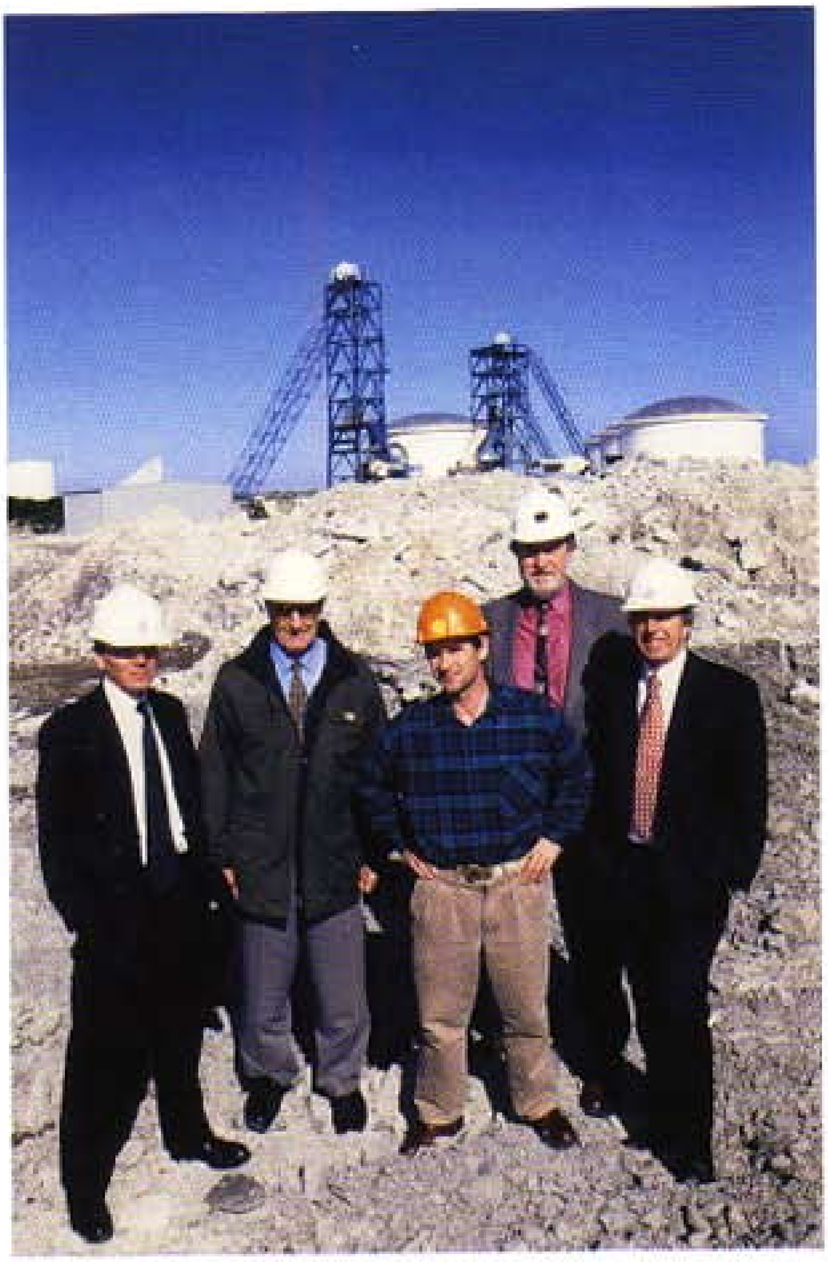
> "Our day on site is spent nestled amongst two giant headframes standing 30 metres high that provide the access to and from the two shafts, which is punctuated by a series of blasts as the Underground Contractor progresses the depth of the two shafts. We spend our day at times counting the number of blasts."[6]

DRILL AND BLAST

With the headframe structures beginning to take shape, the moment had arrived to commence actual excavation of the access shaft through the Hawkesbury sandstone. Using drill and blast methods, the first charge of package explosives

5. Constructed directly above the bedrock, they also served as earthquake support beams.

6. Warring Neilsen in *Elgas People*, November 1996.



The project team, from left: Colin Willis, Joe Zanelli, Jean-Marc Morisseau, Barry Robbins and Warring Neilsen. Behind them are the 30 metre high headframes built over the shafts to support twin deck stages used to hoist people and materials from below ground.

was detonated on 29th July 1996. It was a relief to learn that sensitive equipment monitoring the blasting had recorded no discernible effects, especially on the refrigerated hydrocarbon tank farm on the adjacent site. At the same time, concerns that the percussion effects might somehow damage the area designated as the Cavern storage chambers were allayed.

Blasting was initially restricted to Monday to Saturday from 7am to 7pm, but with the monitoring showing no discernible impact on nearby residents, it was soon allowed to operate around the clock. Drilling and blasting of both shafts moved ahead rapidly. By Thursday 24th October 1996 the access shaft had reached a depth of 46.9 metres, level pegging with the operations shaft at 46.5 metres.

10
The Cavern

UNDERGROUND CHALLENGE

The Cavern stands as one of Australia's greatest, yet least known engineering achievements since the Snowy River Scheme, a half century earlier.[1] The fact that it was built at all is a tribute to the many people involved in the project from start to finish. Six years in the planning, it was to be another half decade before the first LPG flowed from storage chambers deep underground. During this time, Warring Neilsen, project executive, Ian Maloney, Elgas Board representative, and project manager Joe Zanelli,[2] were consumed by one, single ambition: seeing the Cavern through to completion.

To say that site challenges were a constant feature of the project is to seriously understate the case. Gas containment within the Cavern chambers would be a major, though by no means the only, engineering issue to resolve. Keith Kinsella, Project Supervising Engineer from the Snowy Mountains Engineering Corporation explained:

> 'The most important ... engineering issue ... is containment. At a depth of 135 metres to the Cavern floor, there is 1,200kpa of ground-water pressure. The maximum pressure that the gas will be stored at is around 800kpa. It is this difference in pressure, and the full hydrostatic head of water saturating the sandstone, and in fissures in the rock, that keeps the gas contained in the Cavern.'[3]

Kinsella's observation helps to explain why the difficult and time-consuming task of stabilising the rock formations became such a gargantuan operation. In the roof of the Cavern alone, more than 18,000 holes were drilled in which hollow-cored rock bolts were installed. Each of these had to be individually grouted with special cement. Grouting work to control water inflows in the Cavern complex and to ensure gas-tight seals were of a similar magnitude. Similarly, challenges were encountered during blasting and drilling operations. At times, it was simply a case of 'learn as you go'. The reality was that no amount of foresight, experience or contingency planning could anticipate all of the engineering problems that would be thrown up by so huge and complex an undertaking. Everyone involved in the project, from the Elgas team and the major contractors, to the men underground, had a steep learning curve in front of them.

DOWN THROUGH SAND

The Cavern was still in the future when Bob Carr, Labor Premier of New South Wales, officially launched the construction phase of the project on 19th March 1996. By month end, Molineux Point had taken on the appearance of a busy construction site, with heavy earthmoving equipment brought in to level the sandy ground.

Actual work on the Cavern commenced with the construction of foreshafts through 25 metres of sand, and directly above what would be two 140-metre shafts, one for operations, and the other for access.

Consulting engineers Connell Wagner developed an innovative design for the foreshafts, stabilising the interface between sand and rock with a diaphragm wall, capping beam and apron shell structure. A specialist subcontractor excavated the trench walls around each foreshaft using a grab and bucket, and stabilised the trenches with bentonite.[4] Both diaphragm walls were then firmly

1. The Snowy River Scheme was a vast network of tunnels and dams in the Snowy Mountains area of southern New South Wales. Initiated by the Federal Government of Sir Robert Menzies in 1949, it was built to divert the waters of the Snowy River into a series of ponds and catchments that could then be used to generate hydroelectric power.
2. Of C J Zanelli Pty Ltd
3. Keith Kinsella, *Australian Energy News*, March 1999.
4. Bentonite is a material composed of clay minerals, predominantly montmorillonite with minor amounts of other smectite group minerals, commonly used in drilling mud. Bentonite swells considerably when exposed to water, making it ideal for protecting formations from invasion by drilling fluids. Montmorillonite forms when basic rocks such as volcanic ash in marine basins are altered.

ERNIE STEVENTON

AN AUSTRALIAN PIONEER

LIGHT FRACTIONS

LPG has been available ever since Edward Drake drilled the first oil well in Pennsylvania, USA, in 1859, although it seems the refineries of the late nineteenth century had little or no interest in LPG.

Infinitely more important, and valuable, was kerosene – a fuel widely used for heating and lighting, especially in rural areas. Once kerosene had been distilled from petroleum, the residual gaseous compounds were either flared off as a clean burning gas or used to fuel refinery operations. With the exception of some refineries in the United States, liquid petroleum gases were disposed of this way simply because storage (in pressurised containers) and handling proved to be so difficult.

About this time industrial chemists discovered that the lighter 'fractions' created during distillation could be liquefied under pressure.[1] However, it wasn't until the early twentieth century that the potential of LPG as a transportable, useable fuel was fully recognised.

PIONEERING DAYS

By the 1920s oil companies throughout the world were struggling to meet the growing demand for petrol created by the automobile industry. Production was limited due to the difficulties in removing certain gases (propane and butane) that were produced during the distillation of crude oil. The presence of such hydrocarbons made the resulting gasoline 'wild' – hence removal was of paramount importance. It was not long before a new system of pressurised distillation was developed,[2] which succeeded in capturing and storing what had long been regarded as waste gases. A new market for butane and propane, and hence LPG, was about to open up.

ERNIE STEVENTON

Ernie Steventon was the first to market LPG in Australia when his Blue Ray Gas Company commenced operations in 1937.

Steventon imported cylinders of propane gas from the Imperial Gas Company in Los Angeles, and sold them to householders who used his specially adapted heaters and cookers. To begin with demand was small, amounting to no more than 30 cylinders a year. In fact, the first imports were so modest that they came as freight on passenger liners.

Anxious to expand his business Steventon travelled throughout New South Wales to rural agricultural shows, setting up camp and demonstrating the convenience of bottled gas by cooking on a small stove. Later, he toured with a caravan equipped with a full size domestic stove, lights, and a single outlet hot water system – all fuelled from cylinders of gas.

Despite the difficulty in getting financial support from banks which were unable to see the asset value in a cylinder,[3] the number of customers increased. A factory was set up in 1938

1. Robert Murray, *Fuels Rush In: Oil and Gas in Australia*, The Macmillan Company of Australia Pty Ltd, Melbourne, 1972, p. 102.

2. Rosemary Broomham, *Light Fractions: 50 Years of LPG*, Gogas (Australia) Pty Ltd, Sydney, 1987, pp. 2-4.

3. Interview with Rodney Steventon on 3rd February 2003.