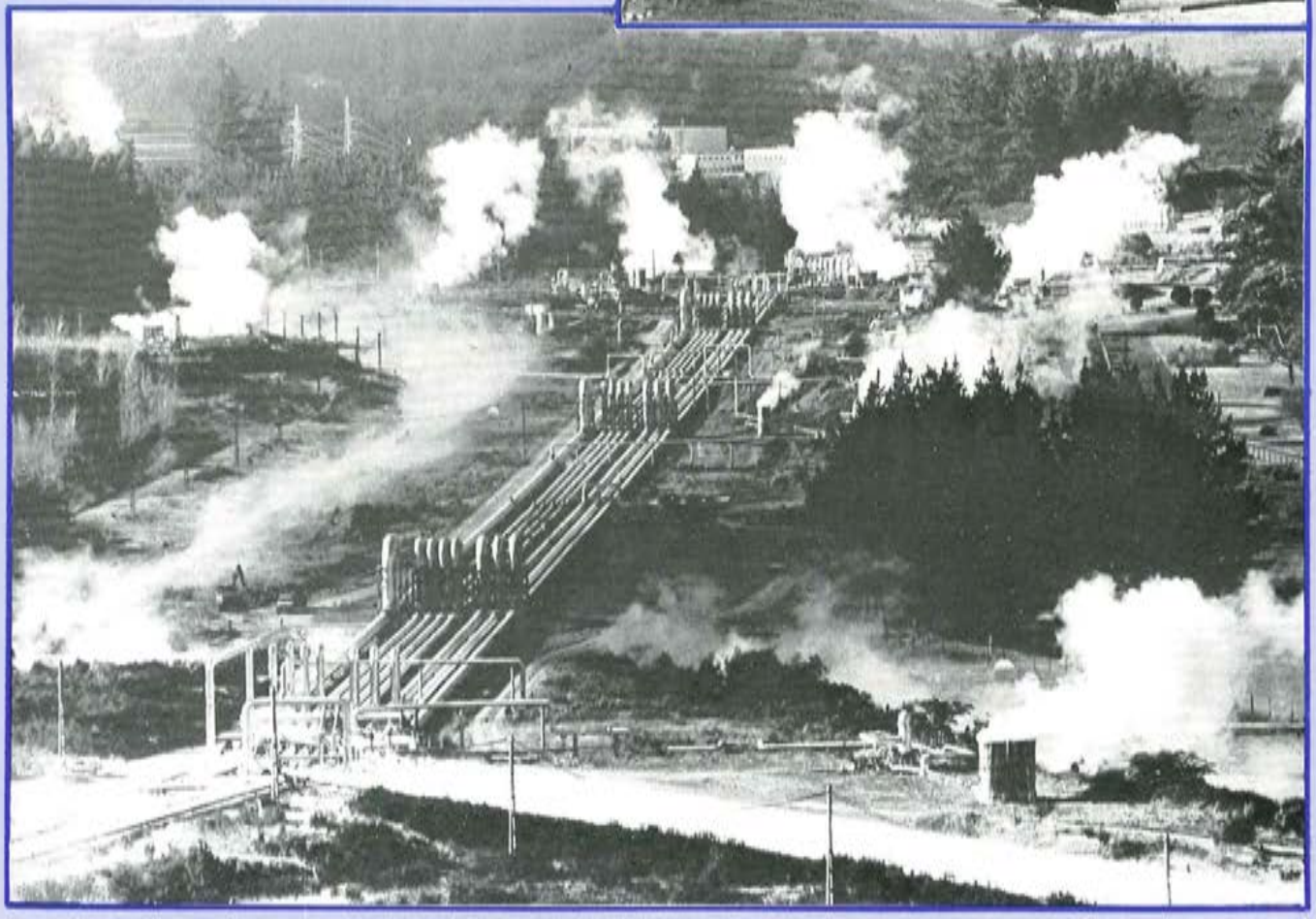
THE DRILLER

Official Publication of
The New Zealand Drillers Federation Inc



SERVICE GUIDE

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PRESIDENTS REPORT

Over the last few months we have been saturated by both newspapers and T.V. news with the plight of the N.Z. Farmer. Spare a thought for the Drilling Industry.

The downturn in the economy is now bighting throughout the country and I feel the Drilling Industry is being asked to take more than its fair share of the load. As an industry we have millions of dollars invested in plant and machinery andhave a workforce probably more skilled than in any other country in the drilling world.

We recently commissioned a random survey of members to ascertain such information as drilling rigs being operated, staff numbers and estimated forward work load. For the six month period ending 30 April 1986, twenty members surveyed depicted a near 50% fall off in work. South Island members showed a massive 75% downturn. All twenty returns for the six months forward to October 1986 show an average operational capacity of approximately 25%.

Coupled with this massive downturn in work we are now faced with government departments such as the M.O.W. Drilling Division and the D.S.I.R. actively tendering for work in the private sector. Just how can the Government expect the Drilling Industry to survive when government departments pay no sales tax or duty on equipment and purchase supplies at bulk rates that are never available to the Drilling Industry.

The President

New Zealand
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Jobs Lost in Dispute

Jobs are being lost at Wairakei because of conflict between two arms of the Ministry of Energy over geothermal resources.

In dispute over geothermal fields are the Electricity Division and the Gas and Geothermal trading group of the Ministry.

Consequent development delays and the new commercial approach of the training group have prompted it to cut back on geothermal drilling. This is causing Ministry of Works and Development staff at Wairakei to be squeezed out of jobs.

And MWD staff want the Government to do something about it.

MWD geothermal projects Public Service Association members met recently to discuss the matter. They decided to demand an immediate government inquiry to resolve what they see as a stalemate within the Ministry of Energy over the development of the Mokai and Tauhara geothermal fields. They want jobs safe-guarded.

Lack of geothermal drilling work for the rest of this year has already resulted in 24 MWD drilling and support workers losing their jobs. They are members of the New Zealand Workers' Union.

And 11 PSA members with MWD's geothermal projects have been earmarked for redeployment.

The Ministry of Energy's gas and geothemal trading group has curbed its orders for more MWD drilling until it sees where it is at with developments at Mokai and Tauhara.

At Tauhara, just outside Taupo, the trading group in joint venture with Fletcher Challenge is negotiating with the Electricity Division over the sale of electricity from a proposed power station there.

At Mokai, to the west, the trading group in joint venture with Ceramco and McConnell Dowell is competing with the Electricity Division to develop the steamfield for power generation. Both groups are hoping Energy Minister Bob Tizard will give the nod to one of them but he has indicated he does not want to interfere.

MWD geothermal project engineer Barry Denton said more drilling work was expected next year but his problem was no one wanted MWD drilling this year.

New Geothermal Field Discovered

Potential new geothermal field discovered.

Scientists from the Department of Scientific and Industrial Research have discovered a potential new geothermal field near Mangakino in the central North Island.

A recent survey of the area revealed an anomalous zone of at least five square kilometres that could indicate a geothermal field.

To test the possibility of such a field the Ministry of Energy commissioned the Ministry of Works and Development to drill a shallow test well, MA1.

According to a DSIR geothermal co-ordinator, Mr Tom Lumb, engineers had trouble controlling MA1 during its drilling — a strong indication of geothermal fluid.

Scientists are unable to say at this stage how significant the field is.

"We hope it will be a major find. The large accumulations of gas found during the drilling of the well are a good sign," Mr Lumb said.

Mr Lumb says investigations from now on will indicate the potential of the field, its life span and how much energy can be drawn from it.

"Our project now is to see at what rate we can extract energy from the field over a 25-year period," Mr Lumb said. This will also determine whether a power station or some other major development is feasible on the site.

Scientists will also investigate possible environmental consequences of such developments.

According to Mr Lumb one of the reasons for bringing the Mangakino field high into priority is the close proximity of the Kinleith pulp and paper mill, a possible user of geothermal steam.

Mr Lumb also says the field would have potential for domestic and light industrial use such as drying crops, heating greenhouses, homes and swimming pools.

The Mangakino survey is part of on-going work by the DSIR, Ministry of Works and Development and the Ministry of Energy. Regional geothermal surveys are aimed at finding out if there are geothermal fields large enough to become a significant part of New Zealand's energy resources.

Geothermal Power Plan

The Ministry of Energy today released its Geothermal Power Plan which plots the future course for this power source in the medium term. In it are outlined the options and opportunities for Geothermal Development available to the nations energy planners.

The plan, which was compiled by the Oil and Gas Division of the Ministry, outlines six geothermal areas which are targetted for development. With the exception of Ngawha, which is north of Auckland, the fields are located in the central North Island, running in a broad belt from Lake Taupo to the Bay of Plenty. These fields, which include Mokai, Rotokawa, Ngatamariki, Tauhara and Kawerau have the proven potential to jointly provide 225 MWe for the national grid. The probable capacity of the fields is 510 MWe and they could possibly produce in excess of 950 MWe.

However, more testing is required to confirm these estimates. The 225 MWe could be available by 1991 if the decision to go ahead was made immediately and would allow more time to evaluate North Island thermal options based on Huntly coal. In addition to these five fields there are a further five areas which are in the early stages of exploration.

A major advantage of geothermal energy is that it can be developed using small modular power plants which can be installed quickly.

Consequently an economic return from electricity generation can be obtained relatively soon after the commitment of funds which results in a better overall return on the investment. Small modular plants also allow power planners a greater degree of flexibilty to meet changing energy demands, a flexibility that is not available with the construction of large power stations.

As with the use of hydro or coal resources for electricity generation, proposals to use geothermal resources have a number of uncertainties. These include the extent of the field, chemical composition of the fluid and well rundown rates. However, because geothermal projects can be developed in small stages, uncertainties can be evaluated early on and steps taken to maximise the efficiency of the plant to give a good financial return. The sociological and environmental impacts of a project may also be lessened by this construction method.

The cost of North Island geothermal developments compares favourable with new South Island hydro, according to figures released in the Plan.

There is the added advantage of having the power in the North Island — close to major users. This takes the pressure off the Cook Strait DC Link which is presently due for upgrading in the mid 1990s.

Ohaaki

Ohaaki will be a Spectacular Sight

Right on schedule for its planned commercial operation in October 1988, the Ohaaki geothermal power station between Rotorua and Taupo won't come onstream with a hiss and a roar like its counterpart at nearby Wairakei.

But although the most modern methods of steam reinjection will largely dispense with the familiar steam clouds of Wairakei, the station will still be a spectacular sight because of the massive 105 metres of cooling tower that will be an integral part of the operation.

The first stage of the Ohaaki development will add about 100 megawatts to the national grid, with 50 megawatts becoming available after October 1988 and another 50 MW after March 1989.

Should it be considered feasible, plans also allow for a possible second stage development, lifting total output to 150 megawatts. However, there is no commitment to this yet.

There is a long history behind Ohaaki.

It is the first power station to be built on land with Maori ownership — the Ngati Tahu people. Their small Ohaaki marae, consisting of a meeting house and dining hall, stands adjacent to the project.

Steam investigations and other testing started in the Broadlands field 20 years ago and final Government approval to proceed with the construction of the power station came in 1982, following agreement with the owners on a lease for the land required on the west side of the Waikato River.

The field is now tapped by 45 wells, about half of which will be used to draw off steam for the Ohaaki project. Wells measure between 1000 metres and 1800 metres deep.

One of the problems with New Zealand's geothermal fields is the toxicity of the separated water, containing poisonous elements including arsenic and boron. Pumped into fresh water they can cause pollution.

At Ohaaki this problem will be overcome by reinjection. It is also expected to reduce ground instability and prolong the life of the field.

Reinjection is used both in Japan and the Philippines but has only previously been tried on an experimental basis in New Zealand.

The plant will consist of two intermediate pressure turbo generators and two smaller high pressure turbo generators which were formerly used in the Wairakei field before failing steam pressure there made their use uneconomic.

Refurbished, they will go back into duty at Ohaaki as an integral part of the power station, although separate turbine houses are being built for the two sets of generators.

The turbines will be driven by a mixture of steam delivered by pipeline from separation plants, which are themselves each fed by an average of five bores sunk into the ground.

The separators will remove the hot water, which will be at about 150 deg C, and reinject it into bores identified for this purpose. About 1800 tonnes per hour will go back into the field.

A massive cooling tower, equivalent to a building about 30 storeys high, will be a feature f the station and will be the first time such a structure has been used in New Zealand. A common sight in thermal and nuclear power stations overseas, the tower will be 70 metres across at the base.

The tower will be used to cool the steam after it has passed through the turbines, condensing the steam into water at a rate of up to 700 tonnes an hour. The natural draught tower will remove about 420 megawatts an hour of heat from the water, which will be circulated by large pumps at a rate of up to 20,000 tonnes each hour.

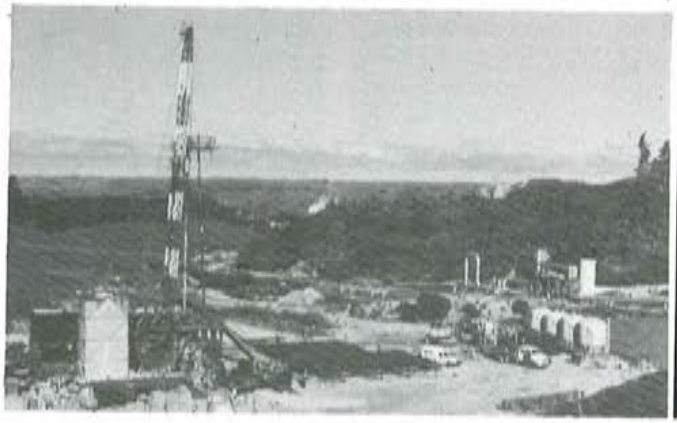
Ohaaki may well prove to be the perfect energy source — clean, non-pollutant, and a development that offers more than just power for far-away places.

The gas content of the steam is another problem. Its potentially damaging hydrogen sulphide will be discharged into the cooling tower and then dispersed harmlessly into the atmosphere.

Yet another remarkable feature of the station is that it is planned to be an unmanned "satellite" station of Wairakei, to which electricity will actually be sent for onward distribution through the national grid.

Fail-safe shut down procedures in the event of any failure will be incorporated into the $280 million plant.

As well as leasing their land, the Ngati Tahu people hope the station will benefit them in other ways, by attracting some of their people back from other areas. They have permission to build further houses on their land, and there are prospects of a horticultural industry there, using steam-heated greenhouses.



New geothermal policies adopted

The Government has adopted new policies which will provide an effective management framework for New Zealand's geothermal resources, the Minister of Energy, Mr Tizard, and the Minister of Tourism, Mr Moore, announced today.

The new policies are based on recommendations contained in a report to Government prepared by an officials committee comprising representatives of the Ministry of Works and Development, Tourist and Publicity Department, Treasury, Commission for the Environment, Department of Lands and Survey and the Ministry of Energy.

Mr Tizard said that the committee was established in 1982 in response to growing concerns about the effect of continued draw-off from some geothermal fields and its effect on surface features. The Committee carried out extensive research into the problems being experienced in managing New Zealand's geothermal resources and in particular sought to determine effective procedures whereby the resource could be allocated to users and amongst competing uses.

Of prime concern was the effect of ever increasing geothermal draw-off from the Rotorua geothermal field and the detrimental effect that this was having on New Zealand's world famous surface features such as the geysers and fumeroles at Whakarewarewa.

Mr Moore says Rotorua is "the jewel in New Zealand's tourist crown" and every possible step has to be taken to safeguard this national resource.

"Rotorua's hot water and geothermal energy are used extensively in every facet of everyday life, while Rotorua is marketed overseas as New Zealand's thermal wonderland. If this geothermal energy is wasted, Rotorua's tourist attractions can only suffer and New Zealand will be denied a unique asset."

"We can't afford to have valuable geothermal energy syphoned off to heat spa pools and hotels at the expense of tourist attractions such as Pohotu geyser. Attention now has to be directed as first priority to protect the Rotorua field."

Mr Moore said he would be asking the tourist industry to play its part in alleviating pressure on Rotorua's resources. He said next on the list should be Waiotapu and Tikitere (Hell's Gate).

Action was already being taken to relieve pressure on the area's geothermal resources: the Maori Arts and Crafts Institute has just advised him that it will be switching to natural gas in the near future.

"The institute has chosen to take a leading role in conserving Rotorua's resources because they saw exploitation reaching dangerous levels."

Mr Tizard said that, in meeting many of the area's day-to-day energy needs, natural gas was a viable alternative to geothermal energy. People in the geothermal area who could now get reasonable access to natural gas should think seriously about using it in preference to geothermal energy.

Speaking about the new geothermal policy, Mr Tizard said its emphasis on management plans for geothermal usage represented a comprehensive effort at managing the resource.

The public would also be given a greater involvement in the planning process, as well as rights to object, and this was another key element in the new policy.

Mr Tizard said the review committee took account of the many submissions made by interested parties after the public was invited to comment on initial proposals, and the policy document's recommendations fairly represented the consensus view.

There are 15 key points in the new policy:

Policy 1

That geothermal water management plans be prepared so that sound management decisions can be made.

Policy 2

That all geothermal well owners be required to obtain water rights to use geothermal fluid, and that all users of geothermal fluid be required to obtain water rights to discharge geothermal fluid.

Policy 3

That protected water status or water conservation orders be applied to those geothermal fields considered worthy of protection.

Policy 4

That all users of geothermal energy drawn from a reservior which has a temperature over 70 degrees Celsius have approved geothermal reticulation systems.

Policy 5

That United Councils and Local Authorities be encouraged to develop policies with respect to geothermal resources which are consistent with the Government's geothermal policy.

Policy 6

That reserve management plans for geothermal features and geothermal water management plans operate together in managing the resources.

Policy 7

That the Environmental Protection and Enhancement Procedures be followed when considering development proposals using geothermal resources.

Policy 8

That Regional Water Boards receive funding from: users of the resource, through a special works and services rate and a levy on water right holders — recoverable under the water and soil legislation; the region through general rating — recoverable under the water and soil legislation; the nation through a contribution from Central Government.

Policy 9

That geothermal energy users be charged a rental to cover the costs of licensing under the Geothermal Energy Act 1953.

Policy 10

That the Crown receive an appropriate return as owner of geothermal resources via a royalty for energy use; a rental for commercial passive use or by a lump sum payment.

Policy 11

That the Waimangu, Ketetahi and Orakeikorako geothermal fields be included in the Schedule of Protected Waters.

Policy 12

That priority be given to preparing geothermal water management plans for the following: Rotorua, Tikitere (Ruahine Springs) and Waiotapu — these have surface features worthy of protection but are also used, or have potential, as energy sources; Te Kopia, Paukohurea, Waikite, Tokaanu-Waihi-Hipaua and Reparoa — these are covered by the present policy of no drilling (except for monitoring purposes); Mokai, Rotokawa, Ngatamariki and Ngawha — these are priorities for energy developments.

Policy 13

That the use of geothermal energy from fields where this is permitted, be actively encouraged.

Policy 14

That licensing geothermal energy use from all of the Rotorua geothermal reservior be brought under the control of one licensing authority.

Policy 15

That all bodies and organisations involved in geothermal resource management meet periodically to review the progress and effectiveness of the goals, objectives, policies and management framework, and make any changes considered necessary.

The full text of the officials' report entitled "Geothermal Resources: A Policy and Management Framework" is available from the Policy and Regulation Division of the Ministry of Energy, Private Bag, Wellington.

Mr Tizard said he will now work with his colleagues towards promoting the legislative changes necessary to implement the new policy.

Initially he will concentrate his efforts in providing an effective system to protect the Rotorua Geothermal field which has so many competing claims for its use. He said he is keen to develop the proposal by the Rotorua District Council that a composite management authority be established for Rotorua made up of representatives of the Bay of Plenty Catchment Commission and the Council.

As far as the other legislative changes are concerned, Mr Tizard said it's hoped that a Water and Soil Bill can be introduced this year and be enacted by April 1 next year. He also hopes to be able to introduce a new Geothermal Energy Bill next year.

Oil exploration

Elaborating on today's statement on Government Expenditure Reform as it affects oil exploration, Mr Tizard said that he saw it as an opportunity for greater involvement in New Zealand by exploration companies.

Mr Tizard pointed out that last December the Government announced that it reserved the right to contribute up to 15% of the costs of exploration under new licences in return for an equivalent 15% share in those licences. "Today's announcement," said Mr Tizard, "means that the Government does not propose to exercise that right, thereby leaving the way open for greater involvement by private explorers."

On another aspect of today's announcement, however, Mr Tizard injected a note of warning to explorers. "The Government is to continue its policy of securing an 11% non-contributory interest in all new licences but will then be looking to sell those interests. Explorers or potential explorers need not think those interests will come cheap," said Mr Tizard.

"That 11% non-contributory interest does not involve the Crown in any expenditure during the term of the exploration licence but gives us an 11% entitlement to any oil or gas development resulting from the exploration," explained Mr Tizard. "It is also an important component in the level of overall Government "take" by which the Government ensures an adequate return from the development of the nation's resource."

He mentioned that other components in the Government "take" are the royalties imposed on the resource and taxation.

"This interest has a potentially high value and the Government expects this to be recognised in any offers it receives," said Mr Tizard.

Big league rigs from Halco

Just over two years ago the Halifax Tool Company in the United Kingdom produced its first high production rig, the HPD 75-35T. At that time, it represented the largest blast-hole drilling rig to be made and sold in Britain. Now a series have been produced, and due to the success of the machines, the range includes smaller medium production units.

The series is not a totally new development by the company, but rather a logical growth from the smaller phneumatic and hydraulic rigs which the Halifax Tool Company has been progressively developing over some 30 years.

The range of machines in the series consists of four high production and four medium production rigs. The high production rigs, exemplified by the HPD 75-35T, is available as a high pressure (350 P.S.I.) down-the-hole hammer or low pressure rotary unit. The series includes the very large HP D115-35T, with a 1150 cfm at 350 P.S.I. compressor, to the smallest in the high production class, the HPD 75-25T model, with a 750 cfm at 250 P.S.I. compressor.

The largest machine in the medium production range is the MPD 60-25T, with a 600 cfm at 250 P.S.I. compressor. The smallest, suited only to rotary drilling, is the MPD 50-125T, with a 500 cfm at 125 P.S.I. compressor. The reason behind the development of an entire range of these rigs was the tremendous success of the first machine. It has been operating for the past two years, averaging about 300m/shift using 140mm (5 inch) blast-hole rods. The cost/m has been exceptionaly low.

The use of very high pressure (750 cfm at 350 P.S.I. for the HPD 75-35T), enables rapid penetration rates to be achieved with the special valveless down-the-hole hammers developed by Halco. There is, however, a price to pay, since these pressures generate very high air velocities at the drill bit and along the rods.

Carrying chippings of abrasive rock, such velocities inevitably have a higher than usual wear effect. The associated costs are nevertheless more than offset by the ability to replace several smaller machines with this one single high production unit.

The high production rigs have a gross mass of 31ft, which ensures a high pull-down force should the machines be used for rotary drilling. The medium production units have a mass of 18t.

The HPD 75-35 T

This machine, like all those in the series, is fully hydraulic, and is entirely operational from within the cab. The prime mover is a Cummins KTA 1150 C series engine, rated at 332 kW. The compressor is a Sullair two stage, heavy-duty screw maching.

The drill mast can handle 7.62m (25ft) tubes. It is of heavy-duty box construction with a single inverted hydraulic ram and chain feed system. Both ram and chain mechanism are fully enclosed and protected from drilling debris or accidental damage. The feed is controlled by an infinitely variable pulldown and holdback system, which allows the precise control of the load on the bit.

Two large-diameter hydraulic rams, with built-in safety lock valves, raise and lower the past. The mast is provided with a hydraulic clamping system, allowing it to be locked at any angle up to 20% from the vertical. Three jacks, equipped with integral safety lock valves, raise and level the complete drilling machine before the mast is raised into the drilling position.

Reprinted with acknowledgement to S.A. Drilling News.

NWWA to meet in Kansas City

The 38th annual convention of the National Water Well Association (NWWA) will be held in Kansas City, Missouri, September 22-24, 1986. Operating with the theme, "Everything's Up To Date in Kansas City", the program, workshops and entertainment will feature the high-tech innovations and technology available to the ground water industry.

Beginning with the Keynote Session on Monday morning, attendees will be treated to a discussion of some of the most important and controversial issues in the industry which affect — or soon will — everyone making their living from ground water.

Nearly 300 exhibitors, representing products and equipment used in the various diversified lines of work represented by today's well drillers and pump installers, will be displaying their latest products and technology in more than 370 booths.

A three-day program of seminars and workshops will be held in conjunction with the exposition. Workshops will be conducted when the hall is not open so there will not be a conflict.

Pre-registration forms will be in the May issue of Water Well Journal, or you can request them from Kathy Butcher, NWWA, 6375 Riverside Drive, Dublin, OH 43017.

The National Water Well Association and the Water Well Journal Publishing Company can now be contacted at their new address:

6375 Riverside Drive
Dublin, Ohio 43017
USA

The new telephone numbers are:

NWWA 614-761-1711
WWJ 614-761-3222

The telex number for both companies will still be:

2411302.

South African designed rig raises interest

A new concept in rig design, which alleviates the need for a derrick to be erected on site, has been designed and patented in South Africa. Once the machine has been levelled, the driller is ready to commence drilling. So far, three such machines have been sold in South Africa, and a further two are on order and are in the process of construction.

Designed by Bernard Gien of P.G. Drilling, the Gien-Drill is 'unique' in that the rods are handled in a semi-automatic manner. The rods can be connected to the rotation head by the operator alone. They are stored horizontally in a magazine mounted on the rig itself. To load a new rod, the rotation head is turned inward by means of hydraulics, and picks up the rod lying in the middle bed, situated between the two magazines. It is then lifted hydraulically into the horizontal position and drilling continues. Using hydraulics, a new rod is rolled into the middle bed, to be ready to be used. Rod handling is hence done directly from the magazine, without the use of a winch or manual labour.

A further advantage of this system is that rods are always drawn from the bottom of the magazine and after drilling, returned to the top. This results in even wear on all of the rods, as the rods must always be used in rotation.

The need for a derrick was alleviated by means of the ingenious use of a hydraulically actuated crane-type arm, which moves vertically and avoids travelling in an arc by means of a 'travelling fulcrum'.

At present there are two such rigs operating within the Johannesburg area, and a third has been built and sold to drillers in Heilbron. Two more are presently in the process of manufacture. One will be used for waterwell drilling and the other for waterwell and also exploration drilling.

A major advantage of the system is that drilling can take place adjacent to a wall or fence, as the rotation head has no need to swivel outward and away from the machine in order to load a new drill rod. Furthermore, as the Gien-Drill has no tower structure, holes can be drilled under overhead obstructions which prevent conventional machines from drilling in the same circumstances.

The result is that the machine is a one man operation, and labour can be used elsewhere. This requirement was a motivating reason behind the development of the rig.

The rig can be fitted with any size or type or rod, depending on the drillers requirement. It is equipped with a water pump for variable water injection from a mist to full flow water. The automatic feed is adjustable from micro feed to rapid feed. Rotation speed is fully variable, in both forward and reverse directions.

It is therefore not suprising that P.G. Drilling has had enquiries from a large company in the United States, regarding a licencing agreement to be signed between the two companies so that machines can be manufactured in that country. Negotiations are presently underway. The Gien-Drill is certainly an innovative design, destined to make an impact on local as well as foreign markets.

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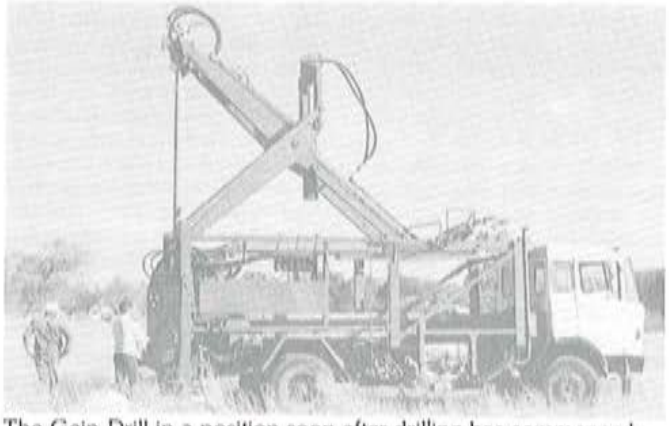


The Gein-Drill in a position soon after drilling has commenced. The 'moving fulcrum' is almost in its extreme upright position.

This side view of the rig shows the drill rods loaded in the magazine.

The central hydraulic cylinder has been lowered to a position indicating that the rod has been completely drilled into the hole.

Primitive well drilling techniques: Part I

Sometimes the oldest way of doing something is the best way.

Particularly in developing countries, primitive drilling techniques may turn out to be more useful and beneficial than modern methods. Last year, NWWA's Research Facility prepared a manual on the subject for the U.S. Agency of International Development (AID). The unpublished manuscript has been highly praised by reviewers — so I thought you'd appreciate an advance look at our study of early drilling methods.

Even modern water well contractors may find these methods useful when constructing rural water supply wells for developing nations.

History of well construction

Considered in its broadest sense, the construction of "wells" may actually have begun before the dawn of human civilization. For example, digging for water in a dry stream bed during a drought is an animal instinct.

Archeological records show that dug well technology achieved a remarkable degree of sophistication several thousand years before the Christian era. Wells of considerable depth were constructed throughout the Middle East in ancient times. Picks and shovel-like tools were probably used for digging and windlass hoists removed material from the bore.

As civilizations became more advanced, excavation needs diversified. Smaller and deeper holes in a variety of earth materials were necessary for quarrying operations and for constructing brine and water supply wells.

Percussion drilling systems

Percussion drilling works on the premise that a heavy, sharp object successively lifted and dropped will gradually bore through earth. Early drill bits consisted of a chisel-shaped flat

stone or metal bit. Some sort of weight or "sinker bar" was attached directly above the bit.

By the end of the 19th century, sinkers were being constructed as sliding linkages (known as "jars" in the U.S.). As the linkages opened and closed, the sharp impact provided extra force to the bit on the downstroke. A corresponding blow on the upstroke freed the bit, which otherwise ight have become stuck at the bottom of a deep hole. The drill string (bit, jars, and any other weights added to the assembly) was securely attached to a drilling "line" a rope-like material or rigid rods. This ran to the surface and transmitted the vertical motion.

Percussion drilling systems evolved independently in many parts of the world, but the basic tools employed were remarkably similar. In fact, many of the 3000-year-old tools resemble those in use today.

One possible explanation for this resemblance is that the problems to be solved were so similar. Throughout the world, communities frequently required water from aquifers overlain by hard soils and rock. These just could not be efficiently penetrated by digging.

Three basic "power sources" were used in early percussion drilling: the springboard, the springpole, and the walking beam. The first was primarily a Chinese drilling technique, while the others were developed or refined in the United States.

Chinese springboard drilling

In 1122 B.C., Chinese wells were drilled to obtain salt for vast inland areas. As late as 1940, methods used for drilling deep wells for brine and natural gas in remote Chinese provinces were still labor-intensive, almost totally unmechanized and dependent on bamboo as a major rig component.

Figure 1 shows that the derrick consisted of a two-legged tower which carried a crown block. Two bracing legs were used to support. A line for raising and lowering the frill string ran over a pulley and back to a large horizontal spool turned by oxen.

The reciprocal percussion motion was produced by human power. A long rigid, horizontal plank served as a lever with drilling tools lashed to the short side of the fulcrum; a crew of laborers took turns raising the drill string by jumping onto the opposite end of the plank. When the laborers jumped off, the tools dropped to the bottom of the borehole under their own weight. A small team of properly synchronized jumpers could drill at a rate of twenty or forty strokes per minute.

Drilling line was made of pliable bamboo strips about 40 feet (12 meters) long. The strips were notched and lashed together with strong hemp cord and rawhide. A single strip was usually strong enough to support tools down to 1500 feet (457 meters). Multiple strips were used for drilling beyond that depth.

American springpole method

One of the world's simplest and cheapest methods of well drilling was developed in the U.S. at the beginning of the 19th century. The springpole method, as it came to be known, was invented in 1807 by David and Joseph Ruffner. In an attempt to augment the flow of a salt spring which supplied their commercial salf factory in Kanawha County, West Virginia, the Ruffner brothers devised an apparatus capable of imparting a reciprocal motion to a heavy chisel-type bit (Figure 2).

This apparatus consisted of only a few working parts. Most important was a long, straight pole large enough in diameter to adequately support the tools while maintaining enough flexibility to generate a lifting/dropping motion. Heavily weighted on the butt end with logs or boulders, the pole was supported by a forked log fulcrum of greater diameter.

The tools — a 2½" (6.4 centimeter) steel chisel bit augmented by welded steel extension shanks a few years later — were connected by a manila line to the narrow end of the pole. A stirrup device attached near the drilling line allowed two or three men to "kick down" on the pole to initiate and continue the reciprocal percussive motion. A small tripod erected above the borehole facilitated pulling tools from the hole and helped operate a bailing device for hole cleaning.

The Ruffner brothers had to drill 60 feet (18 meters) below the earlier hand-digging limit before they struck an ample flow of brine. Time required: 18 months.

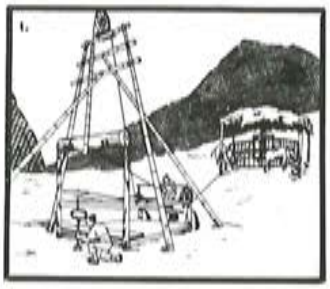
Because salt was a scarce and valuable commodity in the U.S. interior at that time, the economic incentive for salt production was great.

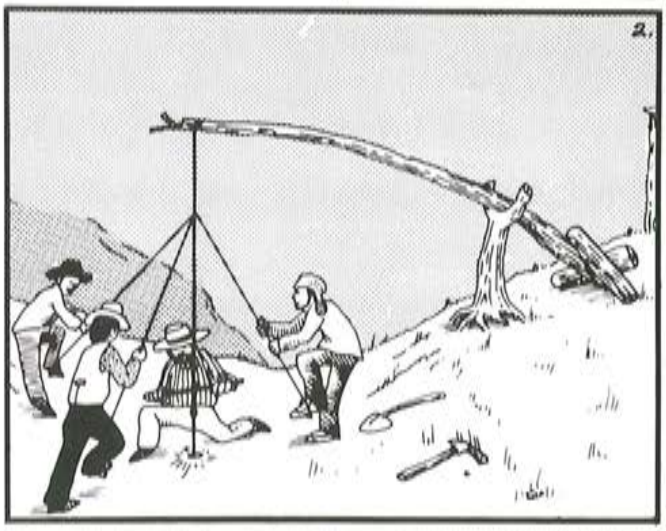
Figure 1. Chinese bring well drilling rig.

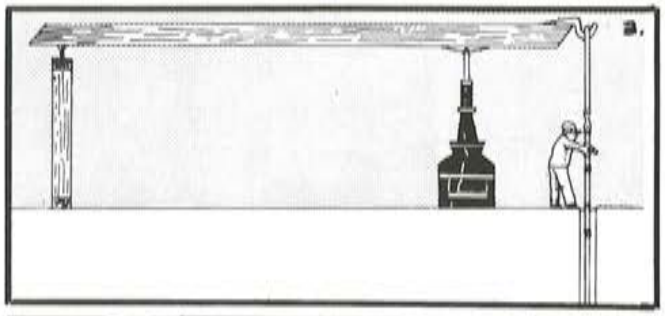
Figure 2. A springpole device.

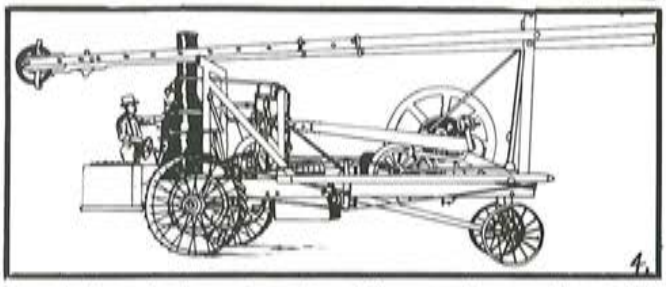
Figure 3. Thom walking beam system.

Figure 4. Portable rig from the early 1900s.









Knowledge of the springpole technique spread rapidly through the Ohio Valley and western Appalachia following the Ruffner's success. Although documentation is scarce, one report indicates that by 1810, brine wells were being drilled 200 to 400 feet (61 to 122 meters) in Cumberland, Lewis, and Perry Counties in Kentucky — a remarkable transfer of knowledge in only a few years.

Evolution of the walking beam

By the mid 1800's the springpole method was already beginning to die out in North America and Europe. It was succeeded by the portable drilling machine made possible by the introduction of steam as a source of power.

Forerunner of the portable rig was the walking beam, which was raised and lowered with mechanical (steam) power. As the flexibility of the long, fixed wooden springpole no longer was necessary, rigs became more compact and ultimately portable. Figure 3 represents one of the first attempts at a walking beam apparatus. Figure 4 depicts an early portable rig.

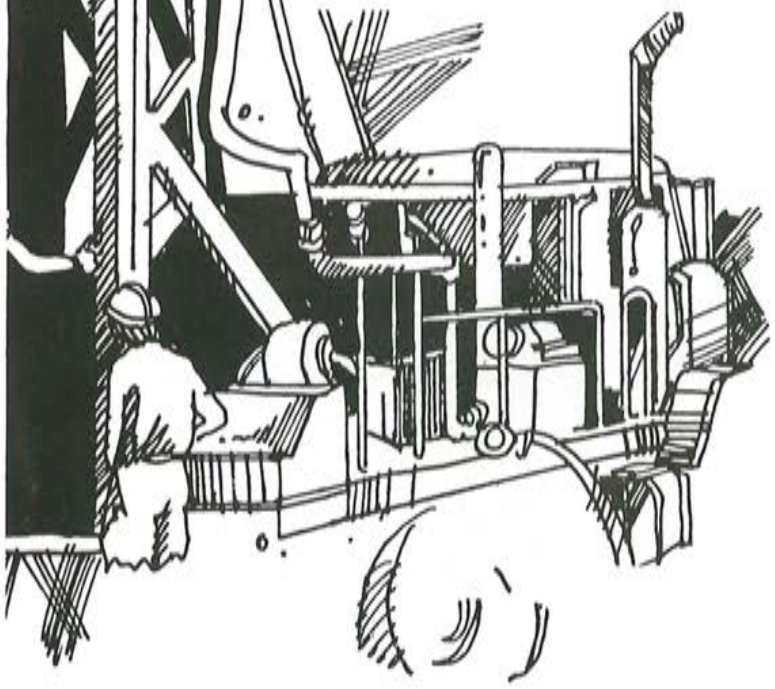
The success of these early mechanical rigs marked the beginning of an entirely new approach to drilling. Well construction could now be undertaken with significantly less manpower.

DRILL TRA

TECHNICAL INFORMATION ON DOWN HOLE DRILLING PROBLEMS

A.D.I.T.C. presents the first of a two-part Technical Information Series for those who experience Down-Hole Problems. This issue looks at Differential Pressure Sticking, a problem familiar to most Drillers. Readers should receive benefit from the following and we invite you to reply with your comments.

There is a common understanding between experienced drillers that on occasions the drilling tools form an attraction to the various formations being drilled. So much is the attraction, that sometimes the tools become part of the formation. The fear of this situation is shared by most drillers.



Production drilling time will be lost while endeavouring to free stuck tools. The forces exerted can lead to drill string failure, consequently the problem becomes more complex and is termed a "stuck fish".

Often the driller is warned of impending sticking, by increased drag as the drill string is raised or lowered, increased torque, or vibration of the drill string. Resistance to movement of the drill string is an indicator of a developing problem. Stuck tools represent a problem but, in fact, they too are an indicator or a result of the real downhole problem. The real problem to be solved is the deterioration in the desired shape, cleanliness or stability of the hole.

Downhole problems, which can result in stuck tools, fall into two groups:

1. FLUID PROBLEMS

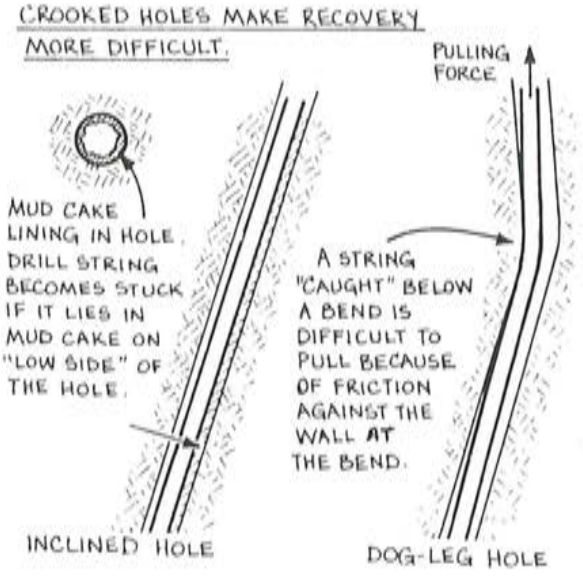
The wall cake building characteristics of the drilling fluid can allow thick sticky wall cakes to build up. Hydrostatic pressures may act to hold the tools in the wall cake.

2. MECHANICAL PROBLEMS

There are many ways of forming a mechanical bind between the walls of the hole and the drill string, some examples are:

- Pulling into a Key-Seat which has formed in a dog-leg in the hole.
- Cuttings or cavings building up a solid "wad" around the string.
- Problem formations swelling or otherwise moving into the hole.
- Running the tools into a ledge or an undersize hole.
- Cementing the drill string.

Down hole problems, leading to a stuck drill string, are always accentuated when the hole is not vertical. The drill rods will lie on the side of an inclined hole and they may be pressed into mud cake deposited on the walls of the hole.



IN NEWS
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Crooked or dog-legged holes are the most likely to cause problems. The risk increases with the severity of the dog-leg. When drilling in "crooked hole country", a driller may have to persevere with some bends, however he should concentrate on reducing the curvature to avoid sharp bends or dog-legs.

Good drilling practices, frequent mud testing and treatment, and close monitoring of the cuttings and fluid return, will allow the driller to recognise early indicators of down hole problems. The driller is then in a position to prevent the problems developing or be able to solve them quickly, before the drill string becomes stuck.

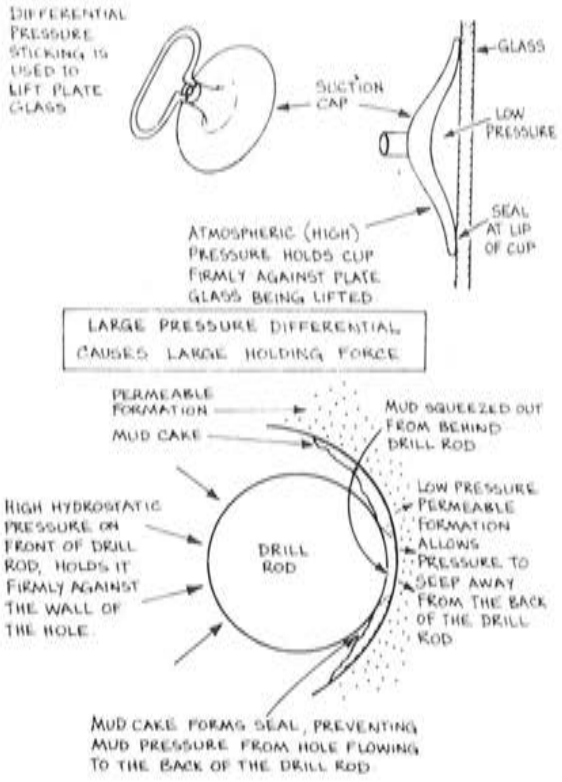
DIFFERENTIAL PRESSURE STICKING

One major downhole problem which can cause the drilling tools "to stick", is differential pressure sticking. It occurs when pipe or rod is held against the wall of the hole by hydrostatic pressure.

Differential pressure stick occurs under the following conditions:

- When the hydrostatic pressure in the hole is greater than the formation pore pressure.
- When the formation is permeable.
- When a thick, poor quality filter cake has been built up over the permeable formation as a result of a slow continuing mud filtrate loss.
- When the rod, pipe or casing is allowed to lie stationary for several minutes against the wall of the hole.

When tools are held by differential pressure sticking, the fluid circulation in the hole is not affected in any way. The drill string cannot be raised, lowered or rotated.



OVERCOMING DIFFERENTIAL STICK

To reduce the tendency of differential pressure sticking:

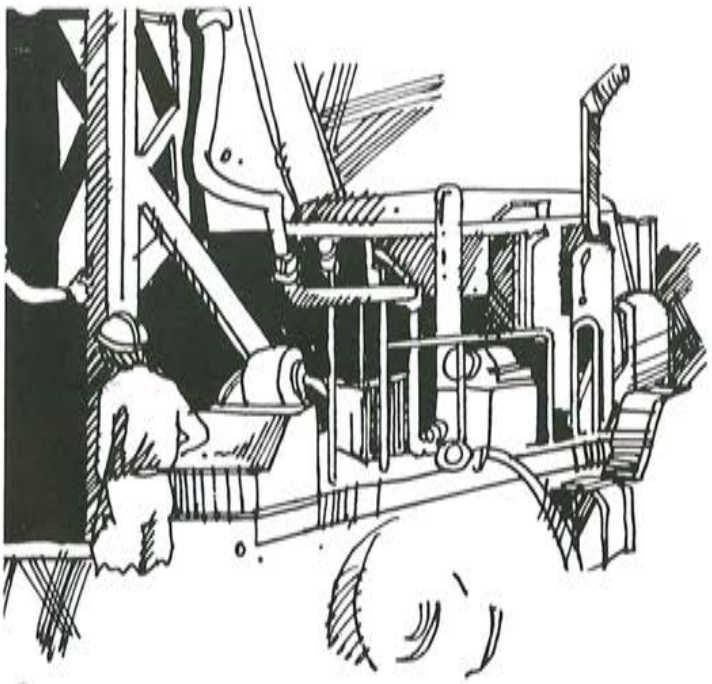
- Reduce the contact area between drill collars and the wall of the hole by running stabilisers or by using square drill collars.
- Maintain good quality muds with low solids content, low water loss and thin tough filter cakes.
- Minimise the pressure differential by running low density muds, aerated muds or foams. Restrict penetration rates to prevent a heavy cuttings load in the mud.
- Keep the drill string moving so that it does not get a chance to "settle into" the mud cake. The tendency to "settle in" is lower in vertical holes.
- When rotary drilling under conditions likely to cause differential stick, some form of jarring tool or bumper sub should be run above the drill collars.

The obvious way to free a drill string held by differential pressure, is to reduce or even remove the pressure differential. In shallow holes, in diamond drill holes and in some water wells, this is the preferred procedure. Before reducing the hydrostatic head in the hole, the driller must consider the risk of causing a blow-out, collapse or caving, which could add to the problem.

When reducing the bottom hole pressure by circulating fluids of lower density or by lowering the standing fluid level, proceed cautiously, while a pull is maintained on the stuck string. Bailing or aeration of the mud are recommended techniques. Knowledge of the likely natural water table level will guide the driller in deciding how far to reduce the head.

When the pressure reduction required to release the pipe is so large that it would cause other problems, circulation of diesel oil or a commercial "spotting fluid" may break down the mud seal and release the string. When the pipe comes free, the hole should be circulated and the mud conditioned, before any other task is performed.

Differential Pressure Sticking is only one of the many problem situations that can be encountered in a drilling operation.



The air drilling alternative

In applications for which is is suited, air drilling can and does offer meaningful time and cost-saving benefits over fluid-drilling techniques. Drilling with air can save nearly half the cost of conventional mud drilling in some cases. Penetration rates can be at least twice those of fluid drilling depending on formations, bit type, mud weight, and viscosity. Drilling with air also extends bit life, making it possible to reduce up to half the number of bits used for a given depth, and also provides the ability to monitor cuttings almost instantaneously.

Air drilling gives excellent results in hard formations, in zones where lost circulation occurs, where few wet zones exist, where cavernous areas exist, or contamination of production zones is a problem.

Even in formations where conditions are less than ideal for air drilling, its benefits can still be significant under certain conditions. For example, 1) you can air drill if the lithology indicates that a long shale section can be isolated with casing without significantly increasing cost in casing design; 2) air drilling applies to any section of the hole that can be drilled with water-loss controls (12 cc per gallon water loss); 3) long water-sensitive sections in most holes can be air-drilled if it is economical to case off the water zones above these sections; 4) air drilling works where a small-diameter hole has to be drilled throgh hard limes, anhydrites, and quartzitic zones; 5) other good possibilities include production zones; these formations can be air-drilled even when flowing with up to 40 gravity crude oil, and gas up to 20 million cubic feet per day; and 6) air drilling offers potential in some portions of the hole in most drilling programs.

More Wells for Wairakei

Extra wells will have to be drilled in the Wairakei geothermal field to prevent the 26-year-old power station from running out of steam.

The Ministry of Works and Development is in the final stages of drilling a well for the electricity division at the moment, but is not yet known how successful it will be.

"We are not very happy about this one so far, but it could turn out to be a boomer yet," said the station generation superintendent, Mr Keith Wilson.

The Wairakei power station was about 7 per cent down on its maximum capacity and had been for some time.

"We would like to be running at 100 per cent output, which is why we are drilling holes to maintain our future supply of steam."

The station produces power from about 60 of the 120 wells drilled so far over the years. A "bonanza of a well" drilled last year was the first new well for about 10 years, Mr Wilson said.

But to maintain full capacity, he expects that one or two holes a year will need to be drilled "just to top it up."

If successful, the well being drilled at present will provide part of the steam supply for next winter.

The cost of drilling a geothermal well ranges from $1 million to $2 million. Each hole can take up to a month to drill and at least a year for a steam-line to be built and the well brought into service.

"You get your money back fairly quickly if the hole is a good one," said Mr Wilson.

The Wairakei power station was designed to last 20 years, but would continue running until at least the turn of the century.

Arab Water Technology Exhibition '86

The Australian Trade Commission (AUSTRADE) is planning a national group participation for the 4th Arab Water Technology Exhibition in 1986. The exhibition will be held in the Dubai International Trade Centre, United Arab Emirates, from October 12-16.

The Arab Water Technology Exhibition and Conference is the established showpiece event for the international water industry serving the Middle East and the States of the Arabian Gulf in particular.

It enables supplies of technology, equipment and services to mount a comprehensive presentation at a time when any of the states in the region are actually increasing expenditure to develop new resources of water for domestic, industrial and agricultural use.

The Arab Water Technology Exhibition and Conference is the established event that the specialists in each of these countries take account of when planning how they can most effectively meet the water requirements of the expanding number of domestic, industrial and agricultural consumers.

The 1986 exhibition will be held under the patronage of H.H. Shaikh Hamdan Bin Rashid al-Maktoum, UAE Minister of Finance and Industry, and this high level of government support is an important factor in attracting specialists to the event from Ministries and public sector organisations throughout the Arab world.

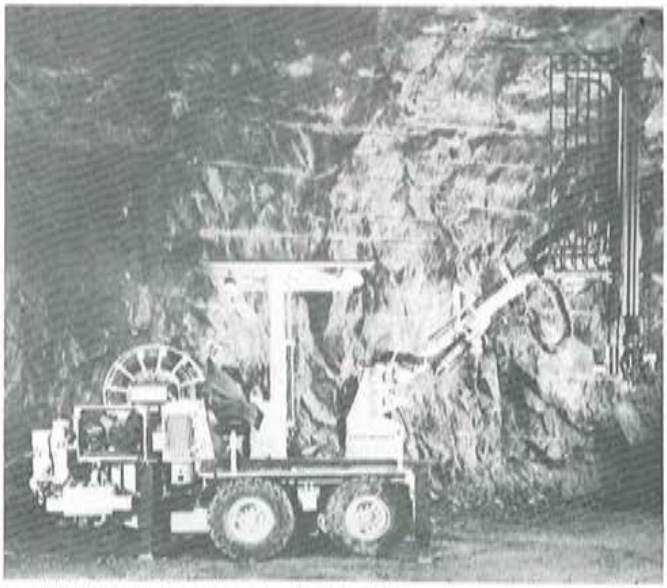
The Arab Gulf states offer the biggest market in the Middle East for suppliers of water related equipment and services and Dubai, as the leading centre of commerce in the area, is the ideal location for the Arab Water Technology series of exhibitions.

The Dubai International Trade Centre provides the best purpose built exhibition and conference facilities in the Arabian peninsula and, as H.E. Humaid Bin-Nasser al-Owais pointed out during the 1984 event, the UAE is now embarking on an important new phase of water development projects.

Dubai is easily reached from the key centres in the Arab Gulf and also has close trading links with Iran. It combines a relaxed social atmosphere with a well developed business infrastructure and is a favourite rest and recreation venue for the other Gulf states.

Companies interested in participating should contact:
Mr R.J. Howse
Programs and Promotions
International Operations
Australian Trade Commission, Canberra, ACT
Telephone (062) 72 2516,
Telex AA 62193.

Atlas Copco's new range of service trucks



Atlas Copco's service trucks, the PT carriers, can be used for a wide range of applications. Pictured here is a Brokk PT 50 scaler for roof heights up to six metres.

Atlas Copco has recently introduced a range of service trucks for mechanized charging, mechanized scaling and other underground service requirements. They are manufactured in three standard sizes with widths varying between 1.4m and 2.4m and are capable of carrying a wide range of accessory equipment. This combination provides the flexibility necessary to satisfy the most demanding of customer requirements.

These trucks can also be used as carriers for small tunnelling or production drilling rigs. This enables the customer to standardize his maintenance and spare parts requirements for all the vehicles in the mine.

The trucks are available in two forms: Either as complete vehicles for specific purposes. Among the different kinds of equipment which can be mounted on the trucks are a series of scissor-lift tables, various types of service boom and ANFO charging equipment. Alternatively, the trucks can be used with a series of interchangeable modules.

Several different modules are available, e.g. for charging, material and personnel transport, fuel and lubrication.

1987 Pacific Rim Congress

Delegates from as far afield as Japan and the Americas have indicated their intention to attend the Pacific Rim Congress 87 (Pacrim), to be held at the Conrad International Hotel and Jupiter's Casino Complex on the Gold Coast, on 26-29 August 1987.

The international Pacrim congress will focus on the geology, structure, mineralisation and economics of the Pacific Rim, and provide geoscientists with a complete, up-to-date understanding, from basic mechanics to exploration methods and problems.

Geologists will have the opportunity to present local knowledge of their region and its economic and political realities, together with the region's economic potential.

Each country and state represented at the congress can participate in the major trade display covering specialised and laboratory equipment, textbooks and latest publications, and exploration equipment.

All members of the Australasian Institute of Mining and Metallurgy and the Geological Society of Australia will receive registration brochures through their respective journals. A special programme for accompanying persons will be available.

For further information, contact the Pacrim congress secretariat at P.O. Box 731, Toowong Qld. 4066.

Dual-tube drilling system

Several different terms are synonymous for the dual-tube drilling system including double-wall pipe drilling system and rotary continuous sample system. In either case the concept is the same, as illustrated in Figure I. The drill pipe is constructed of two concentric tubes, one within the other.

When drilling with a double wall drill pipe the circulation media, usually air, is forced down the annulus between the inner and outer pipes to the drill bit and then directed to the center of the pipe carrying the cuttings, chips or core-like samples to surface continuously at high velocities. Depending on the formation either drag, open-face, tricone or hammer bits can be used. The double-wall drill pipe is usually flush jointed, permitting the bore hole to be cut with a minimum of clearance. With this type of reverse circulation drilling, the samples are forced to the surface through the center and sample contamination by caving formations or particles eroded from the wall of the hole is eliminated. There is minimal danger of losing samples into voids and fractures.

There are several important advantages and selling points to the dual-tube system.

A. Continuous Samples: The system delivers a 100% representative sample at high velocities continuously to the surfact for collection.
B. Rate of Penetration: With our top-head drive rotaries, hourly and daily production rates are high and higher than conventional core drills. Some situations have been logged as much as 15 times faster, achieving the same results.
C. Operating Costs: Operating costs for sampling are less than other conventional techniques. Bit costs are usually less and because of high rates of penetration and production rates and other special features of the system, total operating costs are usually less than when using other techniques. Operating costs in some cases have been reduced by 75%
D. Hole Deviation: Because of the flush wall and packed assembly, deviation is less than conventional drilling techniques.
E. Surface Casing: Surface casing can be eliminated because of the configuration of the dual-wall pipe. The outer pipe supports the hole while circulation is maintained internally.
F. Lost Circulation: The pipe configuration, maintaining circulation inside, can provide circulation to the surface even while drilling in vugs, fractures, voids and joints.
G. Surface Equipment: Where-ever possible air or air with water injection is used to provide a cleaner sample require water or mud drilling. In either event, smaller volumes than those used in conventional drilling, are required to supply adequate bailing velocities.

The dual-tube system is used in the following specific mineral exploration and sampling applications.

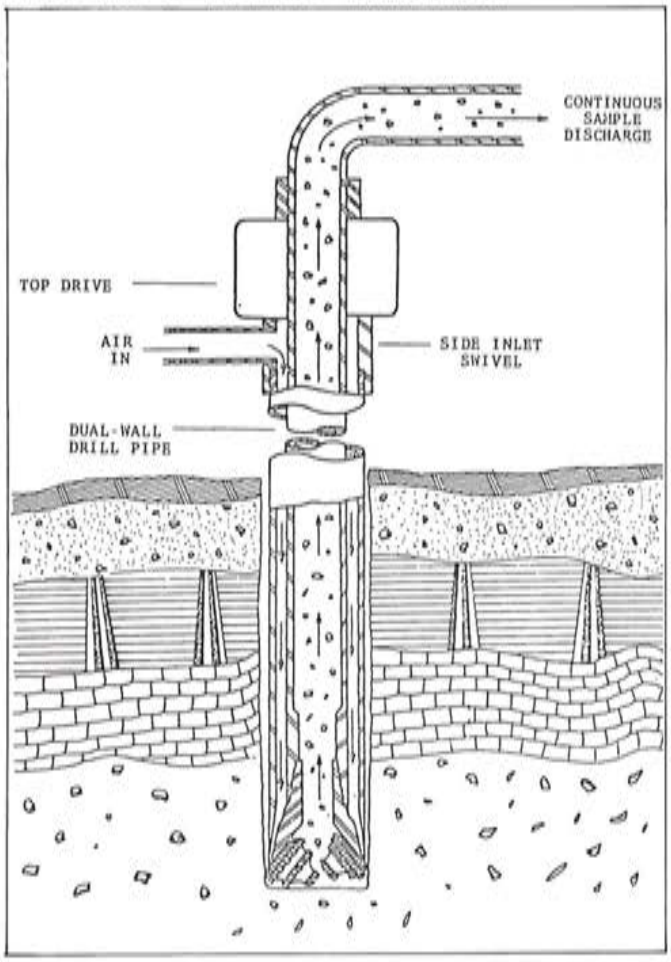
A. Coal sampling, primarily for surface mining deposits.
B. Placer deposits including gold, magnetite, cassiterite, rutile.
C. Phosphate sampling
D. Laterite sampling (Nickel)
E. Uranium exploration
F. Mercury sampling
G. Lithium prospecting
H. Copper exploration
I. Other sulfide sampling projects
J. Vein sampling such as gold
K. Bauxite exploration
L. Diatomaceous earth sampling

The number of dual-tube projects are increasing as more drillers become aware of the potential of the system to provide the information they require faster and more economical than conventional drilling or core drilling.

Sampling procedures vary from application to application. Proper collection of the sample, whether in the form of chips or cores, is the single most important phase of the system. The sample is returned to the surface at high velocity and passed into a pneumatic seperator. From this point the sample is split, tubed, bagged, and boxed depending on the requirements.

The dual-tube drilling system for continuous sample is becoming a rapidly accepted exploratory tool. The technology is expanding and more people are realizing the advantages of the system over other techniques that have been used for many years.

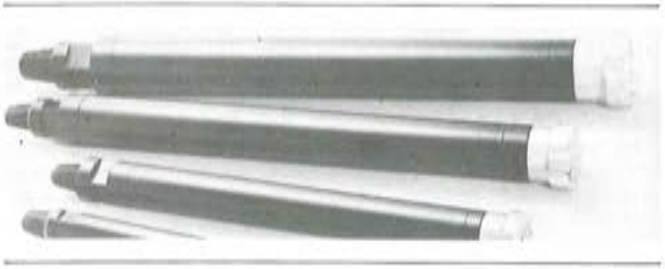
All of the Ingersoll-Rand Cyclone top-head drive machines can be adapted to accept the continuous sampling system, a system that is the answer to many exploratory drilling projects.



Modular water well drill rig

Ideal for smaller wells, the Ingersoll-Rand TH10 top head rotary drill rig has the capability of drilling 100-250 mm dia holes to a depth of up to 230 m. Designed as a 'modular' the TH10 can be mounted on any suitable vehicle, ranging from a small light-weight trailer, the normal two wheel drive truck or tractor, or even a four-wheel drive rough terrain vehicle. The TH10 is suited for rural water supply or monitoring wells where larger rigs cannot gain access to the drilling site.

The unique feature is the new Duo-Derrick which means the TH10 will drill with standard 3 m drill pipes which are easy to transport and can be easily handled by the one man operator. Yet the same Duo-Derrick will handle standard lengths of 6 m casing or pull two lengths of 3 m drill pipe, reducing time and money spent on non-drilling applications.



The new Cop 52 completes Atlas Copco's drills range of down-the-hole

With the addition of the new COP 52 Atlas Copco can now offer a complete range of down-the-hole drills for a whole series of applications in quarrying and construction, everything from bench drilling and the drilling of anchor, grout, drainage, ventilation and conduit holes, up to and including prospect drilling. The COP 52 is a new DTH drill with a hole range from 130-140 mm. So now this range of DTH drills, the COP 32/42/52 and 62, can cover drilling operations in the 3" — 6" range, i.e. hole diameters between 85 and 165 mm.

The designs of these drills are extremely flexible and can easily be adapted to any conceivable type of rock drilling operation. Thanks to the down-the-hole technique, the drills' penetration rates are directly proportional to the operating pressure used. Given the fact that Atlas Copco's DTH hammers can operate at pressures of up to 18 bar, the drills can, therefore, attain exceptionally high levels of production.

The drills are also remarkable for their sample and robust construction, which consists of a mere 12 constituent parts. They are valveless, do not require cylinder liners and have no welded parts. All this means that service and maintenance are simple and can be carried out without the use of specialized tools.

In common with other down-the-hole drills, the penetration rates of these drills is relatively little influenced by the depth of the hole, due to the fact that they operate at the bottom of the hole. This enables the full force of the impact piston to be directly transmitted to the drill bit. These drills are, therefore, ideal for drilling long holes. They are also capable of great directional accuracy, even when drilling upward.

From the environmental point of view these DTH hammers have two highly attractive features: The fact that they operate at the bottom of the hole means that mechanical noise and chatter is effectively muffled. Secondly, rock cuttings and dust are drawn off and accumulated in special dust collectors mounted on the carrier.

Flushing can generally be carried out using the exhaust air from the drill itself. However, it's also possible to add water to the airflow, a technique known as water injection, with or without foam additives. The use of foam serves the triple purposes of binding dust particles, helping to force cuttings up and out of the hole and stabilizing the walls of the hole when drilling in soft rock.

Atlas Copco can also offer a large range of equipment for use with these DTH hammers, for example various types of carriers, feeds and rotation motors. A full range of specially designed Sandvik Coromant button bits is also available. These are manufactured by Sandvik Rock Tools and sold worldwide by Atlas Copco.

Among the most notable of these options is the renowned ODEX equipment for overburden drilling. Like the range of button bits, the ODEX system is another of the fruits of the long and successful cooperation between Atlas Copco and Sandvik Rock Tools. Because it enables drilling and casing to be carried out simultaneously, the ODEX system permits effective drilling operations to be achieved in even the most difficult conditions, such as clay, sand, gravel and other types of unsuitable soil conditions. The fact that an ODEX system has been adapted for use with these DTH drills makes them even more versatile machines.

These DTH hammers are intended for use with Atlas Copco's new range of air crawlers in the ROC 400A series and hydraulic crawlers in the ROC 430H series. However, they can also, of course, be used with Atlas Copco's older rigs — or even with the rigs of other manufacturers. Atlas Copco can also supply a range of portable compressors, providing working pressures up to 20 bar, suitable for use with these drills.

Significant benefits from new submersible pumps

A new range of submersible pumps which offer several unique features, has been introduced to New Zealand by Gilbert Lodge & Co Ltd.

The pumps are from AB Grindex of Sweden, one of the world's leading makers of submersible pumps.

30 models are available including drainiage pumps, sump pumps and sludge pumps designed especially for heavily contaminated liquids, with capacities of up to 14,000 litres a minute and discharge heads of up to 100 meters.

Gilbert Lodge's Industrial Equipment Division Manager, Mr Ron Crook says Grindex pumps are the only submersible pumps which can run dry continuously without burning out or damaging the electric motor, which is achieved through a switch device enabling them to pump air to keep the motor cool.

They also have built-in bimetal motor protectors and thermocontacts in the stator windings which will cut off the power before the motor overheats in the event of a phase failure or a blockage in the impeller (over-current).

Once the fault is rectified, the motor protector is automatically reset, and the pump is operational again.

This is an improvement over the traditional contactor type motor protection which only shuts off after the temperature rises, and which allows the motor to start again when it cools, irrespective of any fault or damage.

Another key benefit of the Grindex pumps identified by Mr Crook, is the fact that their external construction of robust corrugated steel gives them twice the strength of smooth casing pumps and many times the strength of aluminium pumps.

The corrugated hot-galvanised steel can take a pressure of 1200 kg (2650 lb) without damage.

Grindex sludge pumps utilise a unique torque flow impeller system which means the impeller itself is well above the liquid flow with no blades protruding into the flow.

In all Grindex pumps the impeller is manufactured from high grade speciality steel for maximum abrasion resistance even when pumping heavily contaminated liquid. Shafts, bolts, nuts and washers are made of stainless steel, and diffusers near the impeller are coated with wear and oil resistant rubber.

As an added feature the impeller is easily adjusted to compensate for wear and to maintain the full capacity of the pumps without any parts having to be replaced.

Many of the components in Grindex pumps are interchangeable and the standardisation of components is such that it is possible to convert some of the models from high head (H) to regular head (N) or vice versa.

The pumps are very competitively priced, and Mr Crook says there has already been a great deal of interest in the new range, especially from local bodies.

Gilbert Lodge & Co Ltd stocks a full range of the pumps from the 1 HP single phase Minex to the 25 HP 3 phase Matador H. The company also carries a comprehensive range of spare parts, and has an already established nationwide team of service experts available for on-site servicing.

Two executives from the Grindex company, the Export Manager and the Technical Services Manager, were in New Zealand recently for product introduction seminars and service training with Gilbert Lodge and Co.

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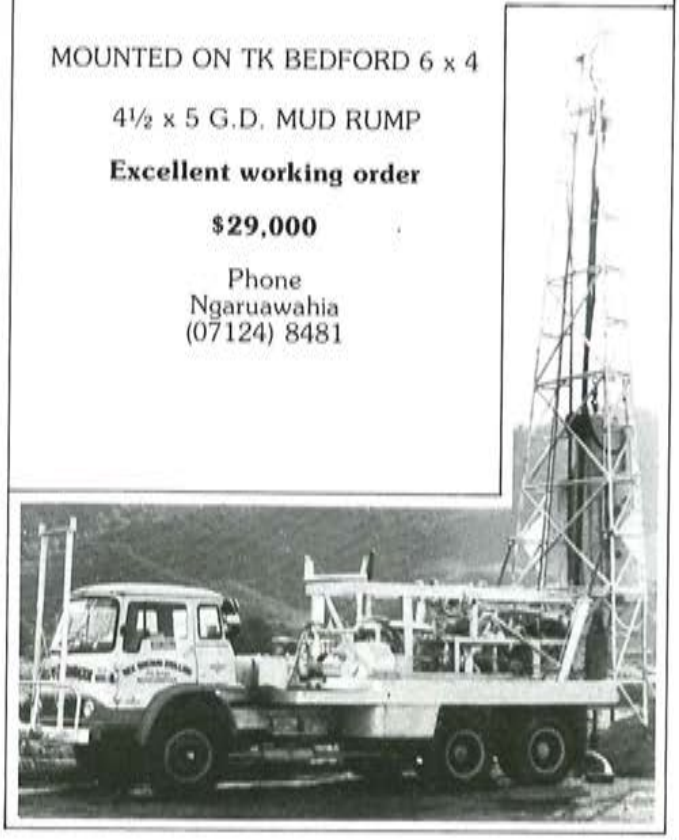

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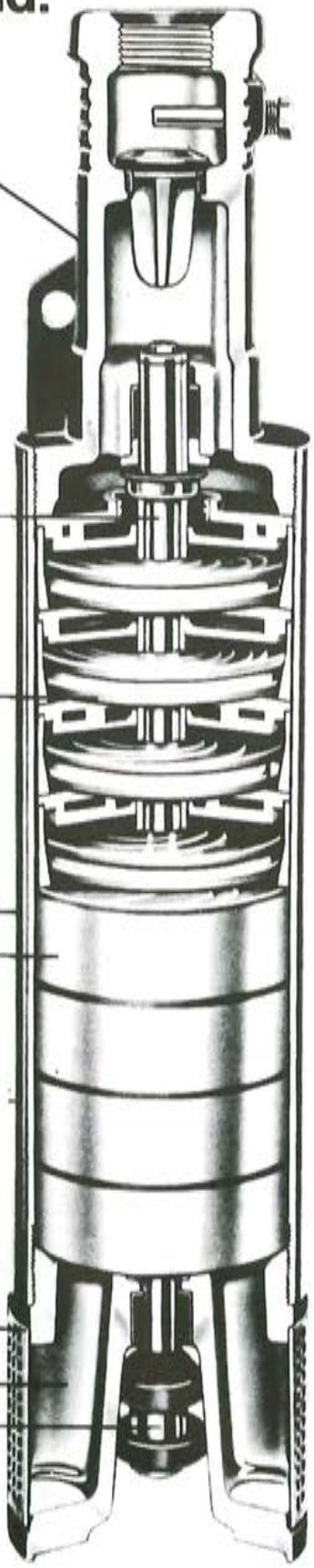

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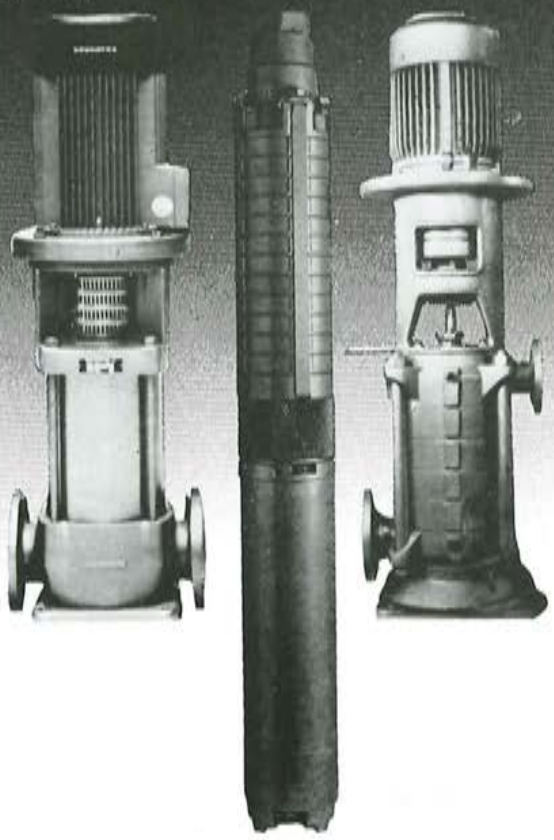

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