

## ENGINEERING ASPECTS OF MINING DEVELOPMENTS

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### SYNOPSIS

This paper, as part of the Legal Research Foundation's Symposium, is essentially concerned with the engineering of a mining project and its effect on the community. The paper also highlights the reasons for changes in mining techniques and compares mining operations in Western Australia and those in New Zealand. Finally on the carrying out of large developmental project such as are at present being undertaken in mining, a plea has been made for simplification in presenting and meeting all requirements in order that such projects are not subjected to too heavy an administrative load, and because of this become a less profitable enterprise or even fail to get underway.

### 1. MINING BILL.

The Mining Bill which was introduced by the New Zealand Parliament in 1969 is essentially a legal document and it is not an Engineer's place to pass any critical comment on it but it does present engineering with some problems which must be taken into account in assessing the feasibility of a project.

The Mining Bill is under consideration by a Select Committee of the House and it will no doubt contain changes when it is reported back.

However because of the many classes of land now under the general administration of various Ministers e.g. National Parks, Scenic reserves, State Forests, Wildlife sanctuaries etc. consent to prospecting and mining have to be obtained from the appropriate Minister in Charge additional to any grant by the Minister of Mines. It may also be necessary to obtain special legislation or a specified departure from any Town Planning Scheme as was the case when New Zealand Steel was established in the Franklin County.

Co-ordination of these requirements can become a

formidable task for the mining industry but such a procedure cannot be avoided and the industry has to accept a responsibility for the protection of flora, fauna and unique features. Requirements in this respect must be incorporated in any plan for developing the project.

## 2. ENGINEERING DESIGN.

In order to present the engineer's problems relative to meeting the requirements of the Bill, and so that these can be appreciated, it has been thought desirable to devote some time to setting out and explaining the stages in engineering design. These, as far as possible, are listed in chronological order:-

### (a) Geological and Geophysical Exploration

Under a Prospecting Licence this is usually the first operation as it provides the greatest amount of mining information at the least cost. In such an exploration there would be a geological and/or geophysical survey which could include such modern methods as magnetometer and gravimeter surveys where appropriate.

### (b) Drilling and Sub-Surface Surveys

With the modern methods of geophysical exploration whereby the measurement of vibrations produced in shallow drill holes by detonating charges produce a reasonably accurate idea of the sub-surface strata there is still, however, a need for drilling. This will inevitably start at a very early stage in the prospecting of a mining area. Such drilling, particularly in alluvial strata takes a great deal of time and it is usually essential for this work to be carried out before any major commitment is made. However, it can effect the operations of the land owners and disturb the countryside and the clauses on prospecting in the Mining Bill provide for compensation to be paid for all damage done and for the rehabilitation and restoration of the area as far as practicable.

### (c) Land Surveys.

Most projects require a land survey which is necessary not only for locating of the project's mineral re-

sources but to delineate the plant sites to be established on or near these and it is also usually necessary to delineate boundaries of the land for the purposes of the Mining Act where a mining licence is required and to meet any requirements where Land Transfer titles are involved.

(d) Layout of Plant etc.

With completion of the above surveys and also having determined sufficient mineral resources to justify economic study, the next stage usually involves site surveys on plant buildings etc. This work is a normal function of any preliminary engineering design and is necessary to produce a reasonably accurate estimate of costs. Again the work involved at this stage should not cause any inconvenience and would generally be carried out during the term of either the prospecting licence or mining lease. However, usually the formalities for the latter which take a considerable time cannot reach finality before the feasibility of the project is established. In determining the layout of the plant there are various approaches which need to be made to local bodies and Government Departments to ensure that any such plant will meet the requirements of these Government and Local Bodies. The various items which come to mind are, in addition to those covered in the Mining Act, those associated with useage of water, polluting areas adjacent to waterways, also such matters as safeguarding areas which are of interest to the National Historic Places Trust and meeting requirements of soil conservation or afforestation. Whilst at this stage all of these matters may not have reached finality the requirements must at least be known so that these can be assessed in making financial studies on capital and operating costs.

(e) Estimate of Capital Cost.

This follows on from the preliminary design of the layout of the plant and accuracy will depend very largely on the accuracy of the designs and the amount of time which has been possible to spend on these. Normally because finance has not been arranged at this stage, the amount of money available for preliminary designs

is limited as it will be wasted if the project does not get under way. As these capital costs are based on the preliminary studies an accuracy of  $\pm 10\%$  is usually all that can normally be warranted at this stage and any estimates quoted more accurately than this should be viewed with suspicion.

#### (f) Feasibility and Profitability as a Mining Operation

Following on the estimate of capital cost of the project preliminary arrangements will be necessary to raise finance for such projects or at least have a clear indication that capital will be forthcoming as the servicing of such capital is one of the largest items in mining operations, and capital cost of plant and equipment being high. At this stage in the profitability, care should be taken to include provision for any additional costs which might be incurred in the carrying out of operations in accordance with the various Government Acts and with local authorities requirements. This has been covered further in the concluding sections of this paper.

### 3. COMMENTS ON PRESENT DAY TRENDS.

#### (a) Earthmoving Operations.

Whereas in the past mining was generally considered as an underground operation by far the largest proportion of mining these days is by open pit methods, where the materials being considered are of a sand or alluvial nature. The principle factor in bringing about this change has been the ease with which the earthmoving can be carried out using large modern equipment and the relatively low costs of this work. It is most interesting to note on costs, that whereas the construction costs over the period of 1950-1970 in New Zealand have risen at the rate of between 4-5% per annum, that for earthmoving alone, particularly over the first 10-15 years of this period, has remained practically constant. The same applied in most other parts of the world and only in recent years has there been a slow increase. This change in the cost structure naturally has been taken advantage of by mining engineers and has meant that where

as underground operations were usually undertaken it is now far more likely that open cast works which generally disrupt the countryside more, will be undertaken. This is to be regretted in some respects but the low cost of earthmoving has also the advantage that more effort can be economically spent on restoring land so that it can be made as workable as it was previously. and in some cases improved upon even to the extent of creating new facilities such as race tracks, and lakes for wildlife and recreation.

(b) Environmental Conditions

The heaps of gravel which were the result of alluvial dredgings particularly in the South Island of New Zealand have been commented on by prominent visitors and when visiting New Zealand Steel's ironsands at Waikato North Head they have pleaded that New Zealand Steel should not do likewise. However, it has been possible at Waikato North Head due largely to the type of material we are using and the ease with which earthmoving equipment can be used, that an area which previously grew forest can be reinstated with the planting of marram grass and lupin to grow forest again and generally speaking on land which is much more easily traversable than previously.

(c) Afforestation

New Zealand with its evenly spread rain fall can benefit greatly from the fact that our open cast areas can be planted readily. Particularly in areas where, due to mining operations tailings are of a sandy nature and poor from the point of view of growing normal pasture, they can nevertheless be afforested readily. There is no reason why this should not be done and by using New Zealand's natural advantage in growing trees make any mining operation a two-fold economic proposition.

(d) Comparison of Western Australia and New Zealand.

Many of the aspects of mining and environmental conditions mentioned above do not occur in Australia and particularly Western Australia. Here there are

vast areas quite uninhabited and without water except where it can be obtained from artesian sources. Consequently the very large mining operations in the West can be undertaken without upsetting the natural environment. Nevertheless the Western Australian Government has seen fit to ensure that any areas into which mining companies move are not only left in good condition but there is an improvement in the environment to ensure that these areas can be permanently inhabited if this is at all possible. In New Zealand, however, we do not have great isolation, natural resources are much more abundant, and we should take even greater steps to ensure conservation and provide adequately for financing this at the time capital and operating costs are being determined for the project. After all, developments in New Zealand even in our most isolated parts are relatively easy of access, because of the compact nature of the country and its equitable climate, and these conditions also lower a project's cost.

#### 4. ADMINISTRATION OF DEVELOPMENTAL PROJECTS

Mining in New Zealand and Australia comes in the category of a major developmental project and in addition to the technical requirements mentioned above it involves any project organisation in many administrative complexities and the following are some of the aspects which have been of concern to administrators in both these countries.

##### (a) Computer Checking of Law Statutes.

Amongst the many aspects of administration which are complex, one problem in the initial stages which is important, and no doubt has been considered by the Legal Profession, is the need for a readily available system of checking statutes which impinge on mining legislation both those in the Mining Bill but more particularly those throughout the statutes of a number of Government Departments. It would seem that to avoid overlooking any requirement such a computer programme on statutes should be readily available to those embarking on large developmental projects and in particular those concerning mining, so that for any particular project the programme will bring to the

Project Manager's notice the various obligations he has to honour as regards land tenure and in the use of all natural resources.

(b) Western Australia's North West Planning & Co-ordinating Authority.

At this stage some comments on the administration of Development Projects in Western Australia would be appropriate and the Minister for Industrial Development in Western Australia, the Hon. Charles Court, on his recent visit to New Zealand made many comments on administration. Although these were largely directed to engineers (he was present at the New Zealand Institution of Engineers Conference) they do indicate the need for a co-ordinating Government Department of Development.

In Western Australia a study was made of alternative ways and means of co-ordinating and activating development - especially in the remote and underdeveloped North, and the North West Planning and Co-ordinating Authority was constituted to cope with this.

This Authority has no statutory authority whatsoever, and it is something created by Cabinet direction and therefore has the maximum flexibility. Simply stated, it is a means of bringing together the senior people in all the various Government departments so as to cut a lot of the red tape and try to make sure that everyone knows what is going on as well as achieving the maximum co-ordination.

It is also a valuable means of consultation and co-operation with the big private projects in the North. This Authority has earned a reputation for speed of decision, commonsense in their study of projects, and appreciation of the practical problems of industrial firms as well as a general capacity to see the broader picture that is inseparable from these huge projects.

They must have recognised that the project itself is not the goal, but a means to an end. The ideal end

should be the betterment of mankind. The big challenge has been to achieve the betterment everyone wants at the price everyone can afford - and this is where the real excitement of development lies.

The Hon. Charles Court, even though himself an accountant and closely associated with economists has stressed the engineering content of administration as being the most important.

Too often the stress on administration is placed first on "money" which is only one of the three "M's" of management, the other two "M's" of management, "men" and "materials" are equally important. Many projects fall down because these two "M's" are made subservient. A great deal of our social and industrial problems result from too great an emphasis on money and on exclusion of the environmental considerations associated with men and materials which of themselves are the real creators of wealth.

#### Multiplicity of Government Departments in New Zealand.

In a recent statement by New Zealand's Ombudsman Sir Guy Powles, who has, in a different capacity had close association with administration difficulties such as we have encountered in furthering new projects in New Zealand, has been most forthright in pointing out the difficulties of dealing with a multiplicity of Government Departments. Sir Guy speaking on complaints which he has received as Ombudsman said: -

"The reasons for most complaints were faults in administration and departmental delays. Delays, however, were a major problem. The time factor rises in geometric proportion to the number of departments involved. If two departments are involved it takes four times as long. If two departments and one board are involved it takes nine times as long, and I've had this happen."

When a major development project such as New Zealand Steel was initiated it had dealings with 14 Government Departments and 10 Local Bodies. Co-ordination



and ensuring satisfaction in meeting the requirements of these statutory bodies is a major undertaking in itself in addition to the need to get the project underway.

(d) Parkinson's Third Law

Finally and with some misgivings Parkinson's third law is quoted which states "Perfection of planned layout is achieved only by institutions on the point of collapse". Like the two earlier laws of Prof. Parkinson this one is somewhat cynical but it does also have some considerable truth in it. During a period of exciting discovery or progress such as we have now in Australia and New Zealand it is difficult to reach perfection in planning. This is not meant to condone any incompetence or lack of efficiency ( the misgivings mentioned above ) and as an engineer this would be inexcusable but perfection for its own sake will achieve nothing and could in fact prevent a project getting underway by the mere complexity involved in trying to meet this perfection.

5. CONCLUSION

In the planning stages if it is not always possible to make detailed provision for environmental conditions and it is suggested that monetary provision as a percentage of capital and operating costs be made, so that when the time comes to make any adjustment in the later planning stages this could be done without upsetting the assessment of profitability. It is only natural that those responsible for the development project would be against doing more than had been provided for when it is no longer possible to alter financing arrangements. But a method such as the above where the monetary provision was made as a normal percentage is usually all that is necessary. With acceptance of this at the time of initiation of the project there need no longer be a source of frustration to those carrying out the project and the goodwill of the community is assured.