COAL RESOURCES of the CARMACKS AREA,

YUKON TERRITORY

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INTRODUCTION

There have been several reports written recently about the coal prospects in the Yukon, especially in the Carmacks area at Tantalus Mine and Tantalus Butte Mine. The main question of reserves is not yet answered and none of the reports can be conclusive until a large block of reserves has been proved up. In the meantime, possible load centres have been identified (see Carr, D.W. 1968: The Yukon economy its potential for growth and continuity) and minimum loads to warrant a thermal electric power station using coal have been established (ibid). Low initial investment and very competitive power prices have been estimated for a thermal power project. The possibility of coking coal being produced in the Carmacks area can be dismissed at this time for although some of the coal will form coke the costs of beneficiation to reach commercial quality are too high.

It must be remembered that the Tantalus Butte coal is in only one of several Yukon coal basins and that some other basins containing Cretaceous and Tertiary coal are much larger with good prospects for the finding of significant coal reserves.

HISTORY

Coal was discovered in the Carmacks area around 1888 when outcrops supplied fuel for gold prospectors. The first commercial mining was carried on at Five Finger Rapids, 8 miles north of Carmacks. The Five Finger Coal mine operated there from 1900 to 1919 driving two slopes on seams of .5 ft. and 4.5 ft. width. The same company opened the Tantalus mine, one mile up-stream from Carmacks in 1905. This mine supplied river steamers until 1922. The mining method was pillar and stall after 1907.

Trenching and stripping began in 1909 at Tantalus Butte, upstream and across the river from Carmacks. The property was bought in 1923 by the Five Finger Coal Company who instituted room and pillar methods. Production then ranged from 300 to 600 tons per year and continued until 1938 when the mine closed for ten years. In 1948 the Yukon Coal Co. owned by Cassiar Asbestos Corp. Ltd. and United Keno Hill Mines Limited re-opened the Tantalus Butte Mine with a federal loan of about $300,000. Production had risen to 14,113 tons by 1954 and then declined as demand by UKHM and river steamers disappeared. The mine closed in 1968, but was held on a caretaker basis until re-opening in July 1969. The new owner-operator is Anvil Mining Corp. Ltd. which operates a lead-zinc mine 90 miles to the east.

Production now averages around 20,000 tons per year or 80 tons per day. Most of the coal is trucked to the Anvil mine at Vangorda Creek, where it is used for concentrates drying and plant heating purposes.

GEOLOGY

The coal deposits in the Carmacks area originated in part of a large Mesczoic geosyncline in the middle of the northwestern Cordillera. In the late stages a seaway known locally as the Whitehorse trough was uplifted. As the sea regressed a series of fresh-water lakes were formed which in the late Jurassic and early Cretaceous became fresh-water coal swamps. As a result, the coal occurs in the Laberge and Tantalus formations at the top of the Mesozoic section. Fossil studies have established a possible time correlation with the Kootenay Formation, but there is no inference that the coal in the Laberge or Tantalus formations forms an extension of the Kootenay or Luscar formations famous for their coking coal.

There were three commercial seams at Tantalus Butte, as described by D.D. Cairnes in 1910 (G.S.C. memoir No. 5). Since then references usually cover a "main" seam which may be the middle seam referred to by Cairnes or a combination of the two lower seams.

The formation is mainly conglomerate and sandstone, while partings in the coal itself are usually mudstone and shale, all non-marine.

The area is characterized by open folds in the competent beds of conglomerate and sandstone. The mine is cut by several faults all trending northeast and producing a graben-like structure. The controlling fault dips about 75^0 northwest approximately 400 feet south of the complimentary faults (which dip southeast). Displacement of the seam along the fault is about 40 feet but the mine workings have followed the one seam. The "main" seam strikes 355^0 and dips 50^0W with average thickness of about 9 feet when referring to the middle seam or 15 feet 3 inches where both lower seams are included.

Further south the coal seams are wildly contorted as they behave as incompetent layers between the beds of conglomerate, sandstone and greywacke, but in the Carmacks area the coal beds follow the fold patterns of the competent beds in the formation.

RESERVES

Three factors must be stressed when considering reserve estimates in the Laberge and Tantalus formations.

1. Because the coal formed in isolated non-marine swamps, the coal seams cannot be assumed to extend with

the formation into new areas.

2. The environment of deposition and the subsequent tectonic activity have produced great variations in seam width over very short distances. (This problem is found throughout the Cordillera).

3. Any reserve figures based solely on geological, structural or even direct evidence must be tempered with consideration for the economics of extraction.

B.R. MacKay in his 1946 study rejected all coal deposits less than three feet thick or at a depth greater than 1000 feet. His estimate for Tantalus Butte was 10 million tons probable reserves and 5 million tons possible and he applied to these figures a recovery factor of 50 per cent.

Estimates of unknown origin which appear in the study by D. Wm. Carr (1968)give values of 3 million tons probable and 50 million tons possible reserves and no mention is made of a recovery factor to be applied.

In 1965, A.D. Oliver reported proved reserves of 400,000 tons and did not speculate on probable or possible reserves.

The estimates of reserves other than the proven 400,000 tons are more speculative than they would be in many parts of Canada and meaningful figures for the

Carmacks area or any part of the Yukon, will require much more exploration.

In 1972 several trenches and a drift were dug to expose the "No. 2" seam at Tantalus Butte. Results of this work, when available may alter the reserve estimates.

QUALITY

The coal at Tantalus Butte is friable, non-coking, high volatile bituminous-C. It burns at a relatively low temperature to produce about 12,000 Btu's per pound. This quality of coal is suitable for domestic and industrial use but cannot be used to produce coke or a clean burning hard fuel without extensive beneficiation.

The physical characteristics were examined by Swartzman in 1948, and the following conclusions were reached.

a) An excessive amount of fines were produced varying from 39 to 71 per cent under ¼ inch depending on the seam and date of sample.

b) The particle size for a composite mine run was 1.017 inches. Swartzman decided that the larger lumps were composed of harder coal.

c) The coal is easily ground and pulverized

d) The coal from the top 3 feet of the main seam was more friable than that from the lower 7.5 feet.

The chemical analyses after Cairnes in 1910 conflict with later analyses by Swartzman, Bostock and Johnstone. Basically a higher water content was assigned to Cairnes' samples which may have resulted from exposure of the seams where sampled.

Combined results of Bostock, Johnstone and Swartzman, from different places on the same seam, were used to produce the following table.

CONSTITUENTS OF TANTALUS BUTTE COAL

H_2O	Volatile	Fixed Carbon	Ash	Sulphur	Heat Value Wet	Heat Value Dry
per cent					Btu's	
3.7- 5.6	30.7- 33.7	48.5- 53.8	8.9- 13	0.4	11,600 12,490	12,550- 12,960

The rank according to A.S.T.M. classification of the data given is high volatile bituminous C.

"The coal was relatively free burning, showed no tendency towards bridging, was non-swelling, and formed only a very light cake over the fire when fresh fuel was charged. However, it was noted that the coal was rather slow to ignite, it lying 'dead' on the fire for some time after charging." (Swartzman 1948).

Of special interest is the low sulphur content; 0.4 per cent typical of western coal but far lower than average

coal from eastern North America.

THERMAL POWER

The case for coal-fired-steam electric plants in the Yukon has been well stated by Carr and Associates. In 1968, 12.8 mega-watts of capacity, amounting to over 40 per cent of the Yukon total, was supplied by diesel-electric plants. The monthly cost for a residential customer consuming 300 KWH from a diesel-electric plant, averaged $30.40 per month.

In a thermal-electric plant as opposed to a hydro-electric or nuclear plant, the fuel costs are a large part of the total cost of electricity. Considering the relatively low cost of construction for a thermal generator which could burn coal or even one which could burn either coal or diesel or fuel oil one wonders why only the diesel generators are now employed.

The Carr report suggests that a thermal plant of 10-100 MW capacity located at Carmacks may be able to supply settlements up to 100 miles away. However, with the exception of a 36 MW unit installed at Glace Bay, Nova Scotia in 1966 the smallest coal-fired plant constructed in Canada since 1963, is of 60 MW size capacity. Although units of smaller size are still in operation, installation of new units of this size would be considered uneconomic. The Carr study suggests building a 10 MW plant, gradually increasing in size to 100 MW. The initial plant would likely face financial

difficulty unless conditions are very unusual or a plant significantly larger than 10 MW can be justified. This would probably entail a transmission grid to cover at least the southern part of the Yukon. The Carmacks station would therefore operate as a base-load station with expansion from an initial IOMW capacity to 100 MW capacity. By this time a new large hydroelectric project might take over and the Carmacks station be relegated to a back-up role. A second cycle of the Carmacks station supplying incremental demands on the base load might be repeated. Such an operation reaching 100 MW capacity would require coal reserves of about 10 million tons and would employ 20-25 people at the plant itself.

RECOMMENDATIONS

There are two major markets for coal in Canada, North America and the world, the thermal electric power market and the coking coal market. The other markets, domestic heating, industrial and transportation are the only ones which have been exploited in the Yukon and now only the industrial market is served. Opportunities for expanding the industrial market for coal will doubtless arise and be capitalized on by industry, independent of any government action, but opportunities for growth, inexpensive electric power and increased employment in

the Yukon will depend on governmental action to aid exploitation of the thermal-electric or coking coal markets. Whether the growth, or the dividends from development of coal, are desirable or able to justify costs incurred will be the primary challenge for government investigation but some basic information is necessary for decisions to be made now.

The exploration licences which have been issued do not even cover all of the Mesozoic coal basins expected to contain sub-bituminous and bituminous coal and even less attention has been paid to Tertiary basins containing lignite. When private industry does not produce basic exploration information the federal government must become involved. The extent of Geological Survey work in the Yukon, while approaching completion of basic mapping, is deficient in estimation of coal seam volumes and total reserves. Until all of the information so far collected by private companies is compiled and summarized and augmented by serious coal exploration studies by the government, no comprehensive estimate of reserves will exist.

Without basic reserve data, decisions will be made which possibly give undue weight to known coal deposits such as those at Carmacks. Such decisions are likely to ignore other areas which are less well explored yet possess more favourable geology for coal discovery.

Specifically the first recommendation is for a thorough search of all publications and records referring to coal in the Yukon followed by field work in areas deemed favourable after consideration of geology, reported coal exposure, and location relative to markets and transportation facilities. The opportunity for surface mining should be examined in each case.

Secondly, the investigations into electric power demand, socio-economic impact of industrial development and transportation are apparently proceeding under the auspices of various federal agencies, the Northern utilities and private companies. Studies of the Carmacks area or other possible coal mine sites would best be taken after the location of prime coal areas have been ascertained.

The interest of electric utilities in the Yukon ought to lead to support of any federal program to explore for coal and evaluation of coal prospects for steam-electric power.

Unfortunately, the discoveries of coking-coal in the Yukon are not really promising. That coal suitable for coking exists is not disputed but any support by companies or agencies outside the government cannot be expected unless a major prospect of high quality coal is discovered. Private exploration is currently being carried on for coking-coal with some success by half a dozen companies. Relative to this, a study of the economic factors involved in producing coal for export or use in

domestic coke ovens should be undertaken, beyond the investigations by D. Wm. Carr and Associates in 1968.

The recommendations of the report by D. Wm. Carr and Associates 1968, Volume 1, page 161-162, echo loudly and I question why they have not been followed.

An export market for coking-coal or possibly thermal coal may open up on the west coast of the United States. The proximity of several coal prospects to the sea may give Yukon coal mines a shipping advantage over other Canadian and American mines. However, the possibility of shipment of coal out of the Yukon would likely be contingent upon construction of a new railway. The WhitePass and Yukon Railway was found unsuitable for shipment of bulk commodities on a large scale, by Crest, several years ago. Also examined by Crest, were several coal showings, with a mind toward coking coal for a smelter; results indicated that the quality of the coal examined was not good enough for serious consideration in that use.

In summary then, utilization of Yukon coal resources will depend on demand for electricity making a large coal fired steam-electric plant feasible or the discovery of very high quality coking coal.

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