BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

# HAT CREEK PROJECT

# PRELIMINARY ENGINEERING

# COMPOSITE REPORT

## APPENDIX D

## COAL QUALITY AND HANDLING

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APPENDIX D

COAL QUALITY AND HANDLING

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## SECTION D1.0 - INTRODUCTION

This Appendix is a review of the two areas that form the essential links between the mine and the powerplant: coal quality and coal handling.

The section on coal quality discusses the process followed in determining the most economic fuel for the powerplant and demonstrates that it is within the limits of current design.

The section on coal handling examines the physical blending, storage and transportation facilities from the mine to the boiler silos required to ensure delivery of a reliable supply of fuel that is within a specified range of quality.

## SECTION D2.0 - COAL QUALITY

### D2.1 BACKGROUND

The quality of the coal to be supplied as boiler fuel will have a major impact on the design and economics of both the mine and the powerplant. Because of the wide range of variability of the coal in the Hat Creek No. 1 Deposit, it is possible to produce a number of fuels of different quality. To form a basis for the selection of the project datum fuel the following objectives were established:

1. The datum fuel must be within the design limitations for conventional North American boilers and pulverizers.

2. A consistent quality of coal within specified tolerance limits must be supplied to the powerplant.

3. Utilization of the coal resource should be maximized.

4. Adverse environmental impacts should be minimized.

5. The energy cost should be minimized - requiring a careful balancing of capital and operating cost factors between the mine and the powerplant.

Consideration of the No. 1 Deposit and the possibilities of improving fuel quality in the light of these objectives identified the following pertinent factors:

1. Improved fuel quality could only be obtained at the expense of reduced resource utilization.

D2.1 BACKGROUND - (Cont'd)

2. Improved fuel quality essentially would mean a reduction in the ash content of the coal burned. The total quantity of waste materials to be handled by the mine and powerplant would not change significantly. However, some of the ash removed from the coal by any conventional cleaning process would be in the form of a montmorillonite-kaolinite sludge, which has been proven to be an extremely difficult product to handle or store satisfactorily, and consequently much more difficult to dispose of than ash from the powerplant. The potential environmental impact of wash plant sludge disposal would be severe.

3. Some reduction in the sulphur content of the coal would be possible. The reduction would be of limited significance because of the known low total sulphur content of Hat Creek coal.

4. The costs of quality improvement would be in the mine and the benefits in the powerplant. It was also apparent that the costs could be established more readily than the benefits.

5. Supply of a consistent fuel quality would necessitate a blending operation whether the coal was washed or not.

In April 1977 the Thermal Engineering Department prepared a target fuel specification, based on available data at that time. The specification was considered to be within the limits of boiler design technology and was accepted by the Mining Department and formed the basis for early evaluations by the mining consultants, Cominco-Monenco Joint Venture (CMJV). Studies completed in March 1978 indicated that the mine could not meet the target specification without washing the coal and an evaluation showed that the costs of beneficiation far outweighed the benefits. It was concluded that washing the coal should only be considered further if the blended run-of-mine coal quality was beyond the limits of boiler design technology.

## D2.1 BACKGROUND - (Cont'd)

Following discussions between the Mining and Thermal Engineering departments and their consultants a revised target fuel specification was agreed upon. This specification provided for a target fuel of 17.1 MJ/kg (7375 Btu/lb), dry basis, and a 25 percent moisture content. Provision was also made for short-term fluctuations in the heating value down to 16.3 MJ/kg (7000 Btu/lb). Further investigation of the impact of this proposed fuel specification was planned by both the powerplant and mining consultants.

The investigation by CMJV included the evaluation of several mining sequences, extensive laboratory testing of the washability characteristics of the coal and the evaluation of a number of possible coal beneficiation processes. In addition, a pilot plant scale washing test conducted at the facilities of the Western Research Laboratory of Energy, Mines and Resources in Edmonton, was arranged to provide practical verification of the laboratory tests. Integ-Ebasco examined the major powerplant performance and cost factors affected by the fuel specification revision.

Two series of combustion studies were conducted. The first tests, in 1976, were in the pilot-scale facilities of the Canadian Combustion Research Laboratories (CCRL) in Ottawa. The second test series, in 1977, involved the burning of 6300 t (7000 tons) of coal in a 32 MW unit at the Battle River powerplant in Alberta. These tests established that Hat Creek coal with a heating value below 6500 Btu/lb dry basis will support combustion and also provided valuable boiler and pulverizer design data.

## D2.2 RESOURCE EVALUATION

The geological structure and the distribution of the quality of the coal in the Hat Creek No. 1 Deposit has been well defined by successive geological drilling programmes. At the completion of the

D2.2 RESOURCE EVALUATION - (Cont'd)

current programme a total of 220 holes will have been drilled on a 150 m x 150 m (500 ft x 500 ft) pattern with a total length of 59 500 m (195,000 ft).

Geological and geophysical interpretations of this drilling have led to the identification of four major coal zones (A, B, C and D) and two waste zones within the coal formation. These four major coal zones have been further subdivided into 14 subzones for detailed evaluation and planning purposes.

Samples of the cores obtained from the drilling have been submitted for thermal value testing and determination of the chemical properties of both the coal and its ash. Evaluation of the results of this testing by the application of both statistics and geostatistics has yielded some important conclusions:

1. The heating value of the coal has a very high degree of correlation with the ash content.

2. The sulphur content cannot be correlated with the heating value to any significant extent.

3. Sulphur and the elements in the ash analysis are randomly distributed (i.e. there is no significant trend in these values).

4. The heating value of the coal (and hence its ash content) exhibits very strong trends. Although these trends vary between the different subzones, they all have a range well in excess of the 150 m (500 ft) drill hole spacing and permit estimating local coal quality with good precision.

Based on the results of the drilling programmes and the geological interpretation that has been developed, estimates of the coal reserves in No. 1 Deposit have been made. The estimate of reserves shown in Table D2-1 are the in-situ proven and probable reserves using a cut-off grade of 9.3 MJ/kg (4000 Btu/lb). Material in the range of 7.0 to 9.3 MJ/kg (3000 to 4000 Btu/lb) is classified as marginal or stockpile quality for possible future alternative uses. Material below 7.0 MJ/kg (3000 Btu/lb) is classified as waste.

A summary of some of the key data on the coal in the proposed 35 year pit is shown in Table D2-2.

The total in-situ moisture content of Hat Creek coal varies and is dependent on the nature and distribution of the ash content and the elevation of the water table.

Based on an examination of the data gathered at Hat Creek and consideration of the moisture reported on equivalent rank coals from other western coal mines, the moisture content for the No. 1 Deposit is estimated to be 25 percent. Several measurements of the run-of-mine coal during the Bulk Sample excavation indicated similar figures, although the saturation conditions of the samples were highly variable. The equilibrium moisture determination for over 140 composite samples in No. 1 Deposit indicate a mean value of 24.0 percent. The inherent moisture content, a level below which the coal cannot be air dried, is approximately 10 percent. The average moisture content of the coal used for the burn test at Battle River was 21.8 percent.

A detailed analytical programme has been initiated to confirm the moisture content during the 1978 drilling programme. A sample was taken directly from the core and a complete proximate analysis including the moisture determination was conducted. Partial results indicate that the estimated 25 percent moisture content may be conservative.

## D2.3 MINING ASPECTS OF COAL QUALITY

Sub-section D2.2 on resource evaluation established the in-situ coal reserve within the proposed 35-year pit. This Sub-section will discuss what could be produced from that pit and the impact of various mining options on the quality of the fuel supplied to the powerplant.

### (a) Dilution and Mining Loss

The quantity and quality of the in-situ reserves quoted in Table D2-2 must be adjusted to reflect practical mining considerations. These factors are:

1. Dilution, which recognizes that in all coal/waste contacts some quantity of the waste material would inevitably become mixed and mined with the coal. The estimated dilution factor is 2 1/2 percent.

2. Coal loss, which recognizes that some coal would be lost because of excessive waste contamination or other operating problems. An allowance of 1 percent is made for coal loss.

The net impact of the combined effect of these factors can be seen in Table D2-3 by comparing the quantity and quality of the "In-Situ Reserves" with the "Run-of-Mine". Invariably the quantity increases while the quality decreases.

### (b) Cut-off Grade

Establishing the cut-off grade (or quality) is probably the most crucial decision that is made for any mining project. The ramifications of the decision are far reaching and the interactions so complex that it is usual for the cut-off grade to be re-evaluated periodically in the light of experience and changing economics.

In its simple form the cut-off grade is the separation point between coal and waste; all material below the cut-off grade would be removed and disposed of as waste; all material above the cut-off grade would be part of the powerplant feed.

An examination of Table D2-3 illustrates the salient points of the effects of changing cut-off grades:

1. Increasing the cut-off grade reduces the quantity of run-of-mine coal while increasing the average quality of the product with a reduction in the utilization of the resource. Simultaneously the cost/tonne of mine product increases.

2. Decreasing the cut-off grade increases the quantity of run-of-mine coal while reducing the average quality of product and improving the utilization of the resource. The cost/tonne of mine product is reduced.

In selecting the cut-off grade the above factors must be balanced against their practical and economic implications for the powerplant.

After consideration of all relevant factors a cut-off grade of 9.3 MJ/kg (4000 Btu/lb) was selected as being most consistent with the objectives noted in Sub-section D2.1:

1. The run-of-mine coal, 17.0 MJ/kg (7327 Btu/lb), would provide a boiler fuel within the range of current North American boiler and pulverizer design capability.

2. The resource utilization anticipated is 94.9 percent within the designed pit. Subjectively this is considered very good.

D2.3 MINING ASPECTS OF COAL QUALITY - (Cont'd)

3. The energy cost would be very close to the minimum possible at Hat Creek.

Selection of a lower cut-off grade would mean a boiler design very close to the limit of present designs for low-rank coals with only a slight improvement in resource utilization. Conversely, a higher cut-off grade would decrease resource utilization without a significant change in boiler design. This decrease in resource utilization would force the design of a larger pit with a consequent increase in mining costs.

An intermediate quality, low-grade coal, has also been established for the material between 7.0 and 9.3 MJ/kg (3000 and 4000 Btu/lb). This material would be handled separately and, while currently planned to be stored in a stockpile, this 16 Mt (17 million tons) would provide an opportunity for further improved resource utilization through:

1. Alternative uses.

2. Possible future upgrading to be acceptable in the blended boiler fuel.

3. Blending with the currently planned fuel, should experience show this to be acceptable.

(c) Selective Mining

Within the coal zones the coal is interlayered with waste partings of variable thickness. If these partings could be removed separately from the coal by selective mining and disposed of with the waste the quality of the run-of-mine coal would be improved. A study of selective mining has concluded that:

1. The benefits would be small in the early years of operation, although this could increase substantially in the later years.

2. Mining costs would increase, due to lower productivity and the application of the smaller equipment required for selective mining.

3. It would be difficult to reliably predict the cost and efficiency of the selective mining of partings of varying thickness and dip occurring at different positions in the mining face.

On this basis no account has been taken of selective mining in establishing the run-of-mine coal quality and mining costs. It is clear that some improvement can be made but the magnitude cannot be established at this time.

(d) Consistent Quality

The objective of providing a consistent quality of coal with minimal variations from a deposit with wide variations would be met by in-pit quality control and by blending the run-of-mine product.

(i) Quality Control

The wide range of variability in the in-situ coal quality would necessitate an extensive quality control programme in the mine. This programme would involve detailed geological mapping and sampling of the exposed coal faces to obtain detailed knowledge of local coal quality variations as a basis for short-term production scheduling and control. It is planned to obtain additional samples in advance of mining by

D2.3 MINING ASPECTS OF COAL QUALITY - (Cont'd)

drilling into the exposed coal benches. These samples would be used as the basis for more detailed mine planning up to 2 years in advance of mining.

(ii) Blending

The required degree of consistency in the quality of coal supplied to the powerplant could only be achieved by blending. A blending system has been designed to smooth quality fluctuations over weekly periods. Provision would also be made for storage of the best quality coal that could be used to improve the blended product if it was significantly below specification. The best quality (D zone) coal would also be delivered alone, when necessary, to meet the MCS requirements of the powerplant.

(e) Run-of-Mine Coal Quality

The mean run-of-mine coal quality to be produced from the 35-year pit after allowance for dilution and losses would be as follows:

| | Dry Basis | As Delivered (25% Moisture) |
|---|---|---|
| Heating value | 17.0 MJ/kg (7327 Btu/lb) | 12.7 MJ/kg (5495 Btu/lb) |
| Ash content | 36.3% | 27.2% |
| Sulphur | 0.48% | 0.36% |

D2.4 COAL BENEFICIATION

Sub-section D2.3 on the mining aspects of coal quality has defined the quality of the run-of-mine coal. This Sub-section describes how the coal could be upgraded to produce an improved powerplant fuel.

D2.4 COAL BENEFICIATION - (Cont'd)

Coal beneficiation is a broad term that encompasses any process that improves the quality of coal. In dealing with boiler fuels this generally implies raising the heating value and reducing the ash content of the coal, but beneficiation can also be effected to reduce the moisture or sulphur content. The majority of the proven beneficiation processes in use are wet, gravity separation processes. Dry processes have been used in the past and new dry processes are under development.

An extensive programme of investigations into coal beneficiation has been completed and is outlined below.

(a) Testing Programmes

Initial investigation into coal beneficiation is normally directed at establishing the characteristics of the proposed beneficiation plant feed and the performance of coal samples in standard laboratory washability tests. Data from these tests are used to predict the performance of the coal in various beneficiation processes. Larger samples of the coal are then processed through pilot-scale beneficiation plants. The results of these pilot plant operations are used to validate the predictions made from the laboratory tests and develop plant design criteria.

In 1973 three bulk samples of Hat Creek coal were obtained by drilling a series of 36-inch diameter bucket-auger holes in the locations shown on Plate D2-1. These three samples represented coals of different quality: 13.2, 18.1 and 20.2 MJ/kg (5700, 7800 and 8700 Btu/lb) dry basis. A portion of each sample was tested in the laboratory of Birtley Engineering to determine the size distribution of the material and to establish the sink-float characteristics. The sink-float test is conducted by introducing the sample into liquids of different specific gravity, usually in the range 1.30 to 1.90 and weighing and analyzing the sink and float products for each fraction. The results of this testing form the basis for the prediction of performance in gravimetric processes. The size distribution of the material and its behaviour during handling and processing are important factors in the selection and evaluation of processes.

The usual practice is to perform the whole series of specific gravity tests on one sample. However, the Hat Creek coal gave erratic results due to its clay content and the procedure was modified so that each sample was split into nine parts with each part being used for one specific gravity test.

The remainder of the three bulk samples was crushed to minus 20 mm (3/4 in). The (3/4 in by 28 mesh) fractions were cleaned using heavy media cyclones and the minus (28 mesh) fractions using water-only cyclones. In the heavy media process the clay coated the media creating density control problems and high magnetite loss. Part of the raw and washed coal samples were shipped to CCRL Ottawa for pilot-scale burn tests.

In 1977 three samples were obtained during the bulk sample programme: two from trench A and one from trench B. Particular care was taken in obtaining these samples to ensure that they represented "as mined" coal rather than the finer coal obtained using the bucket-auger. These samples were sent to Warnock-Hersey Professional Services, Calgary, for a laboratory testing programme designed by Simon-Carves Canada Ltd. This programme was essentially similar to that conducted in 1976 except that a wet attrition test, based on an Australian standard method, was introduced to permit the anticipated degradation during processing to be evaluated in the laboratory. Plate D2-1 summarizes the programme.

D2.4 COAL BENEFICIATION - (Cont'd)

A 73 t (80 ton) sample obtained from trench A during the bulk sample programme was submitted to the Western Research Laboratory of Energy Mines and Resources, Edmonton for evaluation of its beneficiation performance in their compound water cyclone pilot-plant. A second objective of this programme was to evaluate the production and treatment of the liquid tailings effluent.

(b) Conclusions Drawn From Test Results

1. Hat Creek coal is subject to severe breakdown in water especially where there is attrition. The clay particles from the coal form a suspension which can interfere with gravity separation processes. This problem is particularly severe in the heavy media cyclone process, which has been eliminated from further consideration for this reason.

2. Washability data shows that the degree of beneficiation achieved would be relatively low for the effort expended; approximately half the normally expected improvement would be gained.

3. The finer size fractions have increasingly difficult washability characteristics. Since all cleaning processes are less efficient for the finer size fractions, the overall efficiency of any process treating the fine size fraction would be abnormally low.

4. The finer size fractions have increasingly higher ash content. This would limit the effectiveness of a commonly used process for thermal coals where washed coarse coal is blended with unwashed fine coal.

5. The removal of high ash fines by dry screening would be limited to the treatment of low grade coal because of the

difficulty of dry screening at the finer sizes necessary to obtain satisfactory recovery with the better quality coal.

6. The better quality (D zone) coal should not be washed because small improvement in quality would not offset process losses.

7. The tailings produced by any process washing Hat Creek coal would be largely a clay-water suspension, which would be extremely difficult and costly to dewater. The quantity of tailings produced by any process would be dependent on the size of the material and the duration of contact between the coal and water.

8. There would be some reduction in the sulphur content of the coal through washing, with resulting lower powerplant sulphur emissions.

9. Practical beneficiation plants could be designed and operated to clean the Hat Creek coal and their performance could be predicted with reasonable confidence from laboratory tests.

10. The design of a practical tailings disposal scheme would require pilot plant work.

(c) Alternative Beneficiation Processes

A wide range of possible beneficiation processes were reviewed in the light of the results of the test programmes and the process characteristics. Most processes are restricted to a limited feed size range. Six practical plant schemes were selected for further evaluation:

1. Heavy media bath (coarse coal) and water-only cyclone (fine).

D2.4 COAL BENEFICIATION - (Cont'd)

2. Heavy media bath (coarse) with untreated fines.

3. Baum jig (coarse) with untreated fines.

4. Untreated coarse with dried and classified fines.

5. Water-only cyclones for coarse and fine coal (would require crushing coarse coal to minus 40 mm (1 1/2 in). This scheme would be similar to the EMR pilot process.

6. Heavy media bath (coarse) with dried and classified fines.

For each scheme a preliminary modular plant design was prepared and capital and operating cost estimates made. Predictions of plant performance were made based on the available test data.

The six beneficiation schemes were evaluated on the following common basis:

1. The mine would produce 1741 t/h (1915 ton/hr) of coal averaging 17.0 MJ/kg (7327 Btu/lb). The 1741 t/h would be made up of 1000 t/h (1100 tons/hr) from A, B and C zones combined at an average heating value of 14.3 MJ/kg (6146 Btu/lb) and 741 t/h (815 tons/hr) from D zone averaging 20.7 MJ/kg (8917 Btu/lb), all values on a dry basis.

2. The run-of-mine raw coal would have a nominal size of 200 mm x 0 (8 in x 0).

3. The raw coal from A, B and C zones would be screened at a nominal 13 mm (1/2 in) size to give 500 t/h (550 tons/hr) to each coarse or fine coal process.

4. In each scheme, the D zone coal would bypass the process and would be blended with the processed product to produce the "blended final product".

The results of the evaluation are presented in Table D2-4.

A brief description of each of the six schemes is set out below and in Table D2-4.

(i) Scheme 1 - Total Washing: Heavy Medium Bath and Water-Only Cyclones (Modular Washery)

Scheme 1 would consist of three identical modules each rated for a nominal 400 t/h (440 tons/hr) run-of-mine coal capacity. Modules would be fed from the raw coal handling system by separate raw coal feed conveyors; thus each module could be independently set to optimize the product yield from its particular raw coal feed. This arrangement would also allow for any module to be taken out of service for maintenance.

The modules would be constructed to work with a common set of product conveyors:

- Coarse clean coal conveyor
- Fine clean coal conveyor
- Fine untreated coal conveyor
- Discard conveyor

The three coal product conveyors have been included for two reasons: firstly, to facilitate separate product stockpiling if required, and secondly, to give flexibility in product blending without complicating the modular plant layout.

Each module would consist of:

- Raw coal screening section
- Coarse coal washing section
- Fine coal washing section

The design as a series of independent modules facilitates the staged development of the plant, and would greatly simplify the initial commissioning and on-going operator training programme.

(ii) Scheme 2 - Partial Washing Using Heavy Medium Bath (Coarse Coal Only)

This scheme would consist of three identical modules each rated at a nominal 400 t/h (440 tons/hr). Developed from scheme 1, the partial washing scheme would consist of the raw coal screening and coarse coal washing sections.

(iii) Scheme 3 - Partial Washing Using Baum Jigs (Coarse Coal Only)

A partial washing plant using Baum jigs would be designed on a modular basis also with a nominal 400 t/h (440 tons/hr) capacity per module.

(iv) Scheme 4 - Fines Dryer/Classifier

A Fines Dryer/Classifier scheme would dry the fine coal sufficiently to permit extraction of the very high ash fractions by air classification. Further work on the practicality of this system would be needed as a potential problem with clay fines "drying onto" coarser material, rather than liberating cleanly at 0.5 mm (002 in) size, is envisaged.

(v) Scheme 5 - Total Washing: Water-Only Cyclone Washing

Water-Only Cyclone Washing is equivalent to the EMR Canmet scheme on which a bulk wash test was conducted in 1977. Raw coal would be crushed to 40 mm (1 1/2 in) and processed through multiple 600 mm (24 in) diameter water-only cyclones.

A very similar degree of beneficiation to that of total washing, scheme 1, is forecast. Washery costs would be significantly lower, however, the tailings problem would be substantially increased.

(vi) Scheme 6 - Partial Washing of Coarse Plus Dryer/Classification of Fines

This scheme would combine schemes 2 and 4, both of which have advantages. Reservations regarding the dryer scheme remain.

(d) Tailings Disposal Methods

The disposal of tailings from a coal beneficiation process would present a major problem. There would be two basic approaches to handling the problem:

1. Storage of all tailings in a lagoon.

2. Mechanical dewatering.

The storage alternative was eliminated for the following reasons:

1. Lack of a sufficiently large suitable permanent storage area.

2. The clay solids concentration would build up to a level that would render the water unsuitable for use as process water, thus increasing plant water consumption.

3. Within a practical time span the tailings would not solidify. Natural compaction over the life of the project would not likely increase the solids concentration in the sludge beyond the 40 percent range.

4. Potentially severe environmental impacts due to leaching, alienation of large areas of unreclaimable land and the unsatisfactory nature of the tailings would exist.

Table D2-5 "Summary of Tailings Dewatering Methods" outlines the applicability of various methods and equipment to the Hat Creek materials. It has been concluded that the only feasible methods would be conventional flocculation followed by dewatering in solid bowl centrifuges. Two essential reservations must be noted:

1. Solid bowl centrifuges are recommended as the only viable alternative. They are in the early stages of production use on similar tailings. However, the degrees of sludge compaction reported in the EMR flocculation testwork indicate that the machines would be used at the limit of present experience. Larger scale washing tests coupled with pilot plant centrifuge tests on the sludge would be necessary before any wet beneficiation scheme could be proposed.

2. Experience to date indicates that an emergency back-up tailings system would have to be provided. For the tailings quantities envisaged at Hat Creek the lagoon would have to be substantial.

D2.4 COAL BENEFICIATION - (Cont'd)

The tailings product from the solid bowl centrifuges is predicted to be a semi-solid cake with 55 percent moisture. The cake would not be of an adequate consistency for conveying any distance without being mixed with lump discard. It could not be bunkered. The mixture of tailings cake and solid discard would be conveyed and disposed of with other unstable mine waste materials behind the waste retaining embankments.

The relative severity of the tailings problem for various washing schemes can be seen from the following listing of the major items of tailings dewatering equipment for a 1200 t/h (1300 tons/hr) washery:

1. Partial washing using either heavy media bath or Baum jig on coarse coal.

    - one 42.5 m (140 ft) diameter thickener
    - four Bird "H" series solid bowl centrifuges.

2. Total washing using heavy media bath for coarse coal and water-only cyclones on fine coal

    - three 52.5 m (172 ft) diameter thickeners
    - twelve Bird "H" series solid bowl centrifuges.

3. Total washing using water-only cyclones for coarse and fine coal

    - three 56 m (184 ft) diameter thickeners
    - eighteen Bird "H" series solid bowl centrifuges.

## D2.5 FUEL PERFORMANCE EVALUATION

To establish the feasibility of burning various qualities of Hat Creek coal and to develop design parameters for the full size boilers and associated equipment two test programmes were undertaken. The initial programme was on a pilot-scale research boiler followed by a burn test in a small commercial unit.

### (a) Pilot-scale Testing

Pilot-scale testing was conducted in the research boiler at the Canadian Combustion Research Laboratory in Ottawa. The objectives of this programme were:

1. To evaluate the feasibility of burning various qualities of Hat Creek coal by means of conventional pulverized coal-fired technology.

2. To determine the effects on combustion performance of reducing the coals' ash content by washing.

3. To establish, insofar as possible, design parameters for a utility-scale steam generator to burn Hat Creek coal.

Six samples of Hat Creek coal were tested along with a coal of known performance from Sundance, Alberta. The Hat Creek samples were obtained from the bucket-auger drilling programme and consisted of three raw samples and three washed samples obtained from the test washing programme conducted by Birtley Engineering described in Sub-section D2.4(a).

The principal conclusions and comments reported were:

1. Hat Creek coals having a heating value of 13.9 MJ/kg (6000 Btu/lb) or more on an equilibrium moisture basis can be successfully burned using conventional pulverized-fired

technology. This heating value is equivalent to approximately 18.1 MJ/kg (7800 Btu/lb) on a dry basis. However, in the design of steam generators for this coal, it is imperative that reliable facilities be provided for removing the large quantities of ash that would be produced.

2. All three samples of raw Hat Creek coal burned during the programme produced stable flames without support fuel.

3. The three samples of washed Hat Creek coals generally produced hotter, more stable flames than the raw coals. The removal of much of the extraneous clay by washing facilitated handling and drying noticeably. Reactivity was also improved. In a full-scale coal handling system washed coals subjected to normal drainage of surface moisture would likely flow freely without further drying.

4. High clay and moisture content in the Hat Creek coal makes handling difficult. This problem could be minimized by drying the coal to less than equilibrium moisture.

5. The fly ash produced by Hat Creek coal, either raw or washed, has a high electrical resistivity. However, it could be collected efficiently in either a hot or a cold precipitator designed to accommodate the physico-chemical properties of the fly ash. Washing the coal produced no major differences in either the mineral composition or the physical structure of the ash residues.

6. Neither high nor low-temperature corrosion of heat transfer surfaces should be a problem when burning Hat Creek coal.

7. Resource conservation makes it desirable to utilize as much of the Hat Creek coal deposit as possible. By beneficiating all coal with a heating value between 8.1 and 13.9 MJ/kg (3500 and 6000 Btu/lb) on an equilibrium moisture basis, up to 80 percent of the currently recoverable deposit could be burned.

8. The blending of high-grade and low-grade raw coals to obtain an average heating value of 13.9 MJ/kg (6000 Btu/lb) should not be undertaken without further study. Bands or lenses of extraneous clay in the low-grade coal may create handling problems after blending.

9. Compared to raw coal, washed coal would appear to provide a number of benefits. These include a smaller materials handling system at the powerplant, smaller steam generators with smaller auxiliaries and smaller dust collectors, and lower pollutant emissions. In addition, there would be substantial reductions in the erosion of heat transfer surfaces and in the volume of ash deposits to be removed from the furnace bottom. The overall result would be reduced cost and increased availability of steam generator plant.

10. Although Hat Creek coal of reasonable quality could probably be burned in steam generators as large as 750 MW, the absence of direct experience with high-clay coals in equipment of this size makes it prudent to limit the first unit at Hat Creek to a size between 300 and 500 MW. Should scheduling permit, such a first unit could be built and proven before further expansion was undertaken; units installed subsequently, could be scaled up with a higher degree of confidence.

The results of the CCRL pilot-scale tests were considered in the development of the target fuel specification in April 1977 and in the planning of the bulk burn test at Battle River.

(b) Bulk Burn Test

The principal objective of the burn test was to monitor the behaviour of Hat Creek coal of a quality at or near the anticipated minimum acceptable level in a commercial scale powerplant and to obtain data needed for steam generator and ancillary equipment design. Key parameters observed included:

- coal handling
- pulverizer performance
- combustion characteristics (flame stability and ignitability)
- slagging and fouling characteristics
- ash handling
- precipitator performance

The burn tests were conducted in Unit No. 2, a 32 MW (nominal capacity) unit at the Alberta Power Ltd. (APL) Battle River station near Forestburg, Alberta during August 1977.

The fuel selected for the test burn was below the minimum recommended by CCRL to confidently establish a lower limit for the practical burning of Hat Creek coal. The coal used in the test averaged 15.2 MJ/kg (6524 Btu/lb) on a dry basis with individual tests being sucessfully run on samples as low as 13.0 MJ/kg (5600 Btu/lb). The "as received" moisture was 21.8 percent.

The principal results of the bulk burn tests are summarized as follows:

D2.5 FUEL PERFORMANCE EVALUATION - (Cont'd)

(i) Coal Handling

Hat Creek coal did not present major coal handling problems even though precipitation during the period was 50 mm (2 in). This was true for the storage pile, crusher, transporting belt, coal bunker, downspout to feeder, feeder and feedpipe to pulverizer.

(ii) Pulverizer Performance

The pulverizers performed well and at the same classifier setting a higher percentage of minus 200 mesh particles was produced with Hat Creek coal than with Battle River coal. Also, the pulverizers did an excellent job in separating rocks, gravel, etc. from the coal.

(iii) Combustion Characteristics

The Battle River 32 MW boiler was operated with two mills in service as low as 11 MW load (approximately one-third design rating) and auxiliary fuel was used only during wallblower sootblowing periods. A 2-hour test was also run omitting the centre level coal nozzle, so that a larger height between in-service nozzles was created. Under this condition ignition was stable and no problems were observed.

(iv) Slagging/Fouling Characteristics

The ash deposits were easy to remove from furnace walls and did not cause increases in furnace outlet temperature, mainly because larger accumulations would drop off without slagging. Throughout the entire test period, ash deposit probes were installed at all elevations above the burners and in spite of large, very light clinkers found in the dry ash pit, no heavy accumulation was ever collected on a metal probe. This was valid regardless of probe metal temperature which was varied from 315$^{o}$C up to 650$^{o}$C in steps of 27$^{o}$C. Sootblowers removed ash from convection surfaces satisfactorily in spite of the much higher than normal ash burden.

(v) Ash Handling

Ash removal from the bottom ash and precipitator hoppers became a logistics problem as the Battle River ash removal system was designed for an ash content of 7 percent while the test coal ranged from 25 to 38 percent ash. The ratio of bottom ash to fly ash varied significantly depending upon the boiler operating conditions.

The Hat Creek ash system would be designed conservatively for the large amounts of ash.

(c) Evaluation of Results

The bulk burn test provided important practical data to establish the reasonable minimum quality of Hat Creek coal to be used as powerplant fuel. There are other factors that must be considered in designing a practical boiler. These include:

1. The quantity of ash that must be removed.

2. Pulverizer capacity and performance.

3. Avoidance of serious slagging and fouling.

## D2.5 FUEL PERFORMANCE EVALUATION - (Cont'd)

4. Minimization of erosion of boiler tubes and other surfaces in the gas stream.

The current status of technology for boiler and pulverizer design on existing and planned projects was examined to determine their design fuel basis. The limit of current low rank coal design in North America is best defined by the San Miguel Project in Texas, where a 400 MW unit is now under construction and scheduled for operation in 1979. This unit has been designed to fire raw lignite.

Table D2-6 compares some of the principal characteristics of the San Miguel fuel with Hat Creek coal. It is important to note that there is a tolerance in the San Miguel design criteria to allow for fuel of an even lower quality.

In considering the results of the burn test and the San Miguel design fuel it appears reasonable that the run-of-mine Hat Creek coal be accepted as the preliminary design basis for the project since it provides a 10 percent safety margin over San Miguel and is within the performance range established for Hat Creek coal.

## D2.6 EVALUATION OF ALTERNATIVE POWERPLANT FUELS

There are basically three different products that can be considered as powerplant fuel. These are:

1. Blended run-of-mine coal at 17.0 MJ/kg (7327 Btu/lb) on a dry basis.

2. A partially beneficiated A, B and C zone coal blended with raw D zone coal to produce a fuel at approximately 18.4 MJ/kg (7900 Btu/lb) on a dry basis.

D2.6 EVALUATION OF ALTERNATIVE POWERPLANT FUELS - (Cont'd)

3. A fully beneficiated A, B and C zone coal blended with raw D zone to produce a fuel at approximately 20.9 MJ/kg (9000 Btu/lb) on a dry basis.

Table D2-7 summarizes the key factors to be weighed in evaluating the optimum fuel for the powerplant. Reviewing these facts in the light of the previously stated objectives:

(a) Heating Value of Product

The higher heating value products, which are also lower in ash content, would be better from a powerplant design, efficiency and operation point of view; but not to the extent that a significant reduction in boiler capital costs could be anticipated. All the fuels are considered to be within the limits of current North American powerplant design.

(b) Resource Utilization

These figures are the product of the mining recovery of the resource to produce run-of-mine coal and the efficiency of the respective process.

It is apparent that any processing would reduce the resource utilization. Establishing an acceptable level would be a matter of judgement.

(c) Tailings Production

Larger tailings production would increase the degree of reliance on a relatively unproved dewatering process for which there is no acceptable alternative. Any process that washes fine coal would significantly increase the tailings quantity and disposal problems.

D2.6 EVALUATION OF ALTERNATIVE POWERPLANT FUELS - (Cont'd)

(d) Sulphur Content

Some reduction in sulphur content could be achieved by beneficiation. This reduction would not change the powerplant design but could adversely affect the performance of the electrostatic precipitators in the present base scheme.

(e) Moisture Content

The difference in the moisture content of the fuels is not large, but any increase in moisture has the potential to increase coal handling problems and reduce the heating value of the as received coal.

(f) Additional Mining Quantity

An additional quantity of coal would be required to be mined to compensate for process losses.

(g) Costs

The capital and operating costs for the benefication plants are based on the process performance predictions and preliminary design. The mining costs are prorated (from the CMJV Mining Report) for the extra quantity required. All costs are capitalized at a 10 percent discount rate. The water only cyclone total washing plant has not been costed, but could be expected to be slightly lower in capital and operating costs than the heavy media-water only cyclone plant.

(h) Benefits

Only the benefits of the partial washing scheme have been evaluated and these are far outweighed by the additional fuel costs. This evaluation confirms the results of an earlier order-of-magnitude study. It is judged that the total washing schemes would produce similar results.

Further beneficiation cost/benefit studies are recommended.

(i) Recommendation

It is recommended that blended run-of-mine coal be adopted as the datum fuel for boiler design and mine planning for the following reasons:

1. The heating value of 17.0 MJ/kg (7327 Btu/lb) on a dry basis is within the design capability of North American boiler and pulverizer manufacturers.

2. A consistent quality of coal with minimal variations could be supplied to the powerplant provided proper planning and control was exercised in the mine.

3. The level of resource utilization would be better than other alternatives evaluated.

4. On balance the environmental impacts are considered acceptable. The impacts of the alternatives have not been evaluated.

5. The use of run-of-mine coal is expected to produce the lowest power cost, and with appropriate attention to powerplant design features, good plant availability.

## D2.7 FUEL PARAMETERS

(a) Boiler Fuel Specification

The boiler fuel specification provides the parameters that are required for boiler and pulverizer design. An estimate of the fuel specification was prepared from the data available to

D2.7 FUEL PARAMETERS - (Cont'd)

provide the basis for the boiler manufacturers to review the feasibility of design and provide budget prices for suitable boilers and ancillary equipment. Fundamental data for fuel specification has now been developed based on the completed mine plan, the use of blended run-of-mine coal averaging 17.0 MJ/kg (7327 Btu/lb) and the full range of analytical data available.

The procedure followed in developing the fuel specification was as follows:

1. The statistical parameters (mean and standard deviation) were developed for each component of the proximate, ultimate and ash analyses in each of the four coal zones (A, B, C and D).

2. The data for the boiler fuel specification were developed by weighting the mean of each component by the proportion of each zone to be mined in the 35-year pit and calculating the standard deviation.

3. The results obtained in each of the preceding steps were compared to those obtained from the samples within appropriate narrow ranges for each zone and the total deposit. This comparison indicated that there is no significant difference between the parameters of an individual fuel of a given heating value and a blended fuel of the same heating value.

This conclusion is of major importance since it appears that blending coals from the different zones would not create the problem of eutectic mixtures, which frequently results from the blending of certain coals.

The preliminary boiler fuel specification data presented in Table D2-8 shows the weighted mean values for each analytical

## D2.6 EVALUATION OF ALTERNATIVE POWERPLANT FUELS - (Cont'd)

component. The ranges shown are plus or minus one standard deviation, illustrating the variability present in the deposit.

## D2.7 FUEL PARAMETERS

### (b) Size Consist

The mine would supply fuel to the powerplant crushed to minus 50 mm (2 in) size. The distribution of material by size range would be a significant factor in pulverizer design.

Estimates of the size distribution have been developed on the basis of the results of field crushing and laboratory tests. Two estimates have been prepared for coal to be fed to the pulverizers:

1. Normal coal flow from the mine to the blending pile and reclaimed for utilization within a few days.

2. Coal subjected to weathering or long-term storage prior to utilization.

## D2.8 FUTURE WORK

The following continuing coal quality work is planned in order to confirm the design criteria for the mine and powerplant:

1. Review the distribution of the existing data and ensure that it is representative of the deposit.

2. Identify and conduct any necessary additional tests. It is anticipated that further work will be required on ash fusion temperatures.

D2.8 FUTURE WORK - (Cont'd)

3. Develop the boiler fuel data into a final form suitable for the use of a boiler manufacturer in final design work.

4. Submit the final boiler fuel specification for review by an independent specialist consultant.

5. Investigate further the characteristics of the proposed datum coal; particularly the impact of blending the various qualities of coal that constitute the blend.

6. Review the costs and benefits of coal beneficiation.

7. Should coal beneficiation prove to be economically attractive, it would be necessary to obtain further washability test data to confirm the design criteria for a beneficiation plant. It would also be desirable to conduct further pilot-scale tests of coal beneficiation and essential to test the practicability of the proposed tailings dewatering scheme.

TABLE D2-1

NO. 1 DEPOSIT PROVEN AND PROBABLE COAL RESERVES IN-SITU
(9.3 MJ/kg (4000 Btu/lb) Cut-off Grade)

| Zone | Proposed 35-Year Pit Mt | Proposed 35-Year Pit (M tons) | Beyond 35-Year Pit Above El. 450 Mt | Beyond 35-Year Pit Above El. 450 (M tons) | Total Deposit Above El. 450 Mt | Total Deposit Above El. 450 (M tons) |
|---|---|---|---|---|---|---|
| A | 77.5 | (85.4) | 139.5 | (153.8) | 217.0 | (239.2) |
| B | 57.2 | (63.1) | 66.8 | (73.6) | 124.0 | (136.7) |
| C | 60.4 | (66.6) | 31.6 | (34.8) | 92.0 | (101.4) |
| D | 149.1 | (164.4) | 134.9 | (148.7) | 284.0 | (313.1) |
| Total | 344.2 | (379.5) | 372.8 | (410.9) | 717.0 | (790.4) |
| Low Grade Coal 7.0 - 9.3 MJ/kg (3000-4000 Btu/lb) | 16.0 | (17.6) | 67.0 | (73.9) | 83.0 | (91.5) |
| Grand Total | 360.2 | (397.1) | 439.8 | (484.8) | 800.0 | (881.9) |

TABLE D2-2

35-YEAR PIT IN-SITU COAL QUALITY SUMMARY
(9.3 MJ/kg 4000 Btu/lb, Cut-Off Grade)

| Zone | In-Situ Quantity Mt | M tons | Heating Value, db[1] MJ/kg | (Btu/lb) | Ash Content % (db)[1] | Sulphur Content % (db)[1] |
|---|---|---|---|---|---|---|
| A | 77.5 | (85.4) | 13.0 | (5613) | 47.8 | 0.72 |
| B | 57.2 | (62.9) | 17.1 | (7372) | 35.6 | 0.68 |
| C | 60.4 | (66.4) | 14.1 | (6060) | 44.4 | 0.44 |
| D | 149.1 | (164.0) | 21.3 | (9147) | 24.5 | 0.31 |
| Total | 344.2 | (378.7) | 17.5 | (7515) | 35.1 | 0.49 |

[1] db - dry basis

TABLE D2-3

35-YEAR DESIGN PIT
EFFECTS OF CUT-OFF GRADE ON RESERVES
RUN-OF-MINE COAL AND RESOURCE UTILIZATION

| Cut-off Grade | | Coal Reserves - In-Situ | | | | Run-of-Mine Coal[1] | | | | Resource Utilization |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Quality[2] | | | | Quality[2] | | |
| MJ/kg | (Btu/lb) | Mt | (M tons) | MJ/kg | (Btu/lb) | Mt | (M tons) | MJ/kg | (Btu/lb) | % |
| 13.9 | (6000) | 247.4 | (272.7) | 19.5 | (8394) | 251.3 | (277.0) | 19.0 | (8184) | 76.3 |
| 11.6 | (5000) | 318.0 | (350.5) | 18.0 | (7757) | 322.9 | (355.9) | 17.6 | (7563) | 90.6 |
| 10.5 | (4500) | 331.6 | (365.5) | 17.7 | (7635) | 336.7 | (371.1) | 17.3 | (7444) | 93.0 |
| 9.3 | (4000) | 343.8 | (379.0) | 17.5 | (7515) | 349.1 | (384.8) | 17.0 | (7327) | 94.9 |
| 8.1 | (3500) | 351.4 | (387.3) | 17.3 | (7434) | 356.8 | (393.3) | 16.8 | (7248) | 95.9 |
| 7.0 | (3000) | 359.6 | (396.4) | 17.1 | (7339) | 365.1 | (402.4) | 16.6 | (7156) | 96.9 |
| 4.6 | (2000) | 377.8 | (416.4) | 16.5 | (7102) | 383.7 | (423.0) | 16.1 | (6924) | 98.5 |

1 Reflects dilution and mining losses.

2 Heating values quoted on a dry basis.

TABLE D2-4

PREDICTED RESULTS AND ESTIMATED COSTS OF COAL BENEFICIATION SCHEMES

| | Scheme 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **Treatment** | | | | | | |
| Coarse coal +13 mm (+ 1/2 in) | H.M. Bath | H.M. Bath | Baum Jig | None | WOC | H.M. Bath |
| Fine coal -13 mm (-1/2 in) | [1]WOC | None | None | Dry/ Class | WOC | Dry/ Class |
| **Run-of-Mine Coal Analyses (incl. D zone coal)** | | | | | | |
| Heating value dry basis MJ/kg | 17.0 | 17.0 | 17.0 | 17.0 | 17.0 | 17.0 |
| (Btu/lb) | (7327) | (7327) | (7327) | (7327) | (7327) | (7327) |
| Ash content (%, dry basis) | 36.3 | 36.3 | 36.3 | 36.3 | 36.3 | 36.3 |
| Sulphur (%, dry basis) | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 |
| Moisture (%) | 25 | 25 | 25 | 25 | 25 | 25 |
| **Blended Final Product Analyses (incl. D zone coal)** | | | | | | |
| Heating value dry basis MJ/kg | 21.0 | 18.3 | 18.3 | 17.9 | 21.3 | 19.4 |
| (Btu/lb) | (9043) | (7882) | (7853) | (7683) | (9136) | (8333) |
| Ash content (%, dry basis) | 24.5 | 32.5 | 32.7 | 33.9 | 23.8 | 29.4 |
| Sulphur (%, dry basis) | 0.45 | 0.48 | 0.48 | 0.46 | 0.45 | 0.46 |
| Moisture (%) | 26.1 | 25.3 | 25.3 | 24.6 | 26.7 | 24.8 |
| Heating value % yield | 91.2 | 97.6 | 96.6 | 96.0 | 88.9 | 93.6 |
| Weight % Tailings | 12.6 | 2.9 | 2.9 | 0 | 18.9 | 2.9 |
| **Cost[2]** | | | | | | |
| Capital (million $) | 32.7 | 19.2 | 16.0 | 6.3 | [3] | 25.5 |
| Annual operating (million $) | 8.5 | 4.2 | 3.5 | 2.2 | [3] | 6.4 |

[1] Water-only-cyclone.

[2] Excluding tailing lagoon civil works and cost of mining extra coal to compensate for process losses.

[3] Water-only-cyclone scheme based on preliminary interpretation of EMR report, not costed.

TABLE D2-5

SUMMARY OF TAILINGS DEWATERING METHODS

| Method | Costs | Advantages | Disadvantages | Conclusions |
|---|---|---|---|---|
| Conventional Flocculation/ Thickeners | | | | Necessary as initial step in disposal |
| Super Flocculation/ Deep Cone Thickeners | High | Thick sludge | High flocculation costs | Hat Creek material not amenable to this process |
| Lagoon Clarification | Very high civil costs | Flocculants may not be required | Large lagoons required environmentally sensitive | Hat Creek material not amenable to this process |
| Incorporation in Product | Low | Simple disposal | High ash sludge giving very poor handling | Unacceptable to boilers |
| Lagoon Disposal | High civil costs | Sequential reuse | Large lagoon required environmentally sensitive | Hat Creek material not amenable to this process |
| Filter Presses | Very high | High cake solids no flocculants | Batch process labour intensive | Too expensive in capital |
| Tube Presses | Very high | Continuous process | In development stage | Unacceptable |
| Solid Bowl Centrifuges | High | Continuous process; in use on similar materials | High maintenance very high flocculant costs | Only practical means available |

TABLE D2-6

COMPARISON OF HAT CREEK AND SAN MIGUEL FUEL CHARACTERISTICS

| Parameter | San Miguel Design Fuel | Hat Creek Battle River Test Average | Hat Creek Proposed Datum Coal |
|---|---|---|---|
| Heating value - as received MJ/kg (Btu/lb) | 11.6 (5000) | 11.9 (5102) | 12.8 (5495) |
| - dry basis MJ/kg (Btu/lb) | 16.6 (7143) | 15.2 (6524) | 17.0 (7327) |
| Moisture Content (%) | 30 | 21.8 | 25 |
| Ash content - as received (%) | 28.4 | 33.6 | 27.3 |
| Weight of ash/heat input kg/GJ (lb/$10^6$ Btu) | 24.4 (56.8) | 28.3 (65.9) | 21.4 (49.7) |
| Weight of water/heat input kg/GJ lb/$10^6$ Btu) | 25.8 (60.0) | 18.4 (42.7) | 19.6 (45.5) |
| Weight of coal/heat input - as received kg/GJ (lb/$10^6$ Btu) | 86.0 (200) | 84.3 (196) | 78.3 (182) |

TABLE D2-7

COMPARISON OF POWERPLANT FUEL ALTERNATIVES

| Factor | ROM Coal | Partial Washing HM Bath | Total Washing HM Bath WO Cyclone | Total Washing WO Cyclone WO Cyclone |
|---|---|---|---|---|
| 1. Heating value of product | | | | |
| MJ/kg | 17.0 | 18.3 | 21.0 | 21.2 |
| (Btu/lb) | (7327) | (7882) | (9043) | (9136) |
| 2. Ash content (%, dry basis) | 36.3 | 32.5 | 24.5 | 23.8 |
| 3. Resource utilization (%) | 94.9 | 92.6 | 86.5 | 84.4 |
| 4. Tailings production (%) | 0 | 2.9 | 12.6 | 18.9 |
| 5. Sulphur content | | | | |
| kg/GJ | 0.28 | 0.26 | 0.22 | 0.21 |
| ($lbs/10^6$ Btu) | (0.66) | (0.61) | (0.50) | (0.49) |
| 6. Moisture content (%) | 25.0 | 25.3 | 26.1 | 26.7 |
| 7. Additional mining costs (%) | base | 2.5 | 9.7 | 12.4 |
| 8. Cost summary (million $) | | | | |
| - capital beneficiation plant | - | 19.2 | 32.7 | |
| - operating beneficiation plant | - | 78.4[1] | 158.7[1] | |
| - additional mining | - | 35.2[2] | 136.7[2] | |
| Total | base | 132.8 | 328.1 | |
| 9. Benefits (million $) powerplant capital and operating | base | 19.7 | - | |

1 Annual operating costs, uninflated and discounted at 4 percent.

2 Additional annual tonnage at $7.55/t, uninflated and discounted at 4 percent.

TABLE D2-8

BOILER FUEL SPECIFICATION DATA

| | Weighted Average | Standard Deviation |
|---|---|---|
| Ultimate Analyses | | |
| % carbon | 43.90 | ±1.49 |
| % hydrogen | 3.74 | ±0.56 |
| % nitrogen | 0.89 | ±0.15 |
| % oxygen | 14.58 | ±1.44 |
| % sulphur (dry basis) | 0.48 | ±0.25 |
| % chlorine | 0.03 | ±0.02 |
| % ash (dry basis) | 36.30 | ±1.80 |
| Calorific Value (dry basis) | 7 327 Btu/lb | ±300 |
| | 17 043 KJ/kg | ±700 |
| % moisture (run-of-mine) | 25.0 | ±10.0 |
| Ash Analyses (% dry ash) | | |
| $SiO_2$ | 53.72 | ±6.02 |
| $Al_2O_3$ | 28.85 | ±5.01 |
| $CaO$ | 2.63 | ±1.99 |
| $MgO$ | 1.41 | ±0.65 |
| $Fe_2O_3$ | 7.62 | ±4.97 |
| $K_2O$ | 0.52 | ±0.21 |
| $Na_2O$ | 1.18 | ±0.51 |
| $Mn_3O_4$ | 0.11 | ±0.13 |
| $V_2O_5$ | 0.05 | ±0.03 |
| $P_2O_5$ | 0.29 | ±0.30 |
| $SO_3$ | 1.82 | ±0.90 |
| $TiO_2$ | 0.92 | ±0.26 |
| Undetermined | 0.88 | ±0.94 |
| Proximate Analyses (dry basis) | | |
| % ash | 36.30 | ±1.80 |
| % volatile matter | 32.20 | ±4.17 |
| % fixed carbon | 31.40 | ±4.20 |
| Carbon Dioxide (dry basis) | 1.77 | n.d. not determined |

TABLE D2-8 - (Cont'd)

| | Weighted Average | Standard Deviation |
|---|---|---|
| Water Soluble Alkalies | | |
| as $Na_2O$ | 0.24 | n.d. |
| as $K_2O$ | 0.03 | n.d. |
| Ash Fusion Temperatures | | |
| Reducing atmosphere: | | |
| Initial deformation | 1300°C | ±200° |
| Ash softening (H=W) | 1325 | |
| Ash softening (H=1/2 W) | 1340 | |
| Fluid | 1400+ | |

Approximately 8.6 percent of the average fuel indicates an IDT 1200°C.

Approximately 4.2 percent of the average fuel indicates an IDT 1150°C.

| | Weighted Average | Standard Deviation |
|---|---|---|
| Oxidizing atmosphere: | | |
| Initial deformation | 1340°C | ±200° |
| Ash softening (H=W) | 1350 | |
| Ash softening (H=1/2 W) | 1360 | |
| Fluid | 1400+ | |
| Hardgrove Grindability Index | 50 | ±10 |

TABLE D2-9

SIZE CONSIST - POWERPLANT FEED

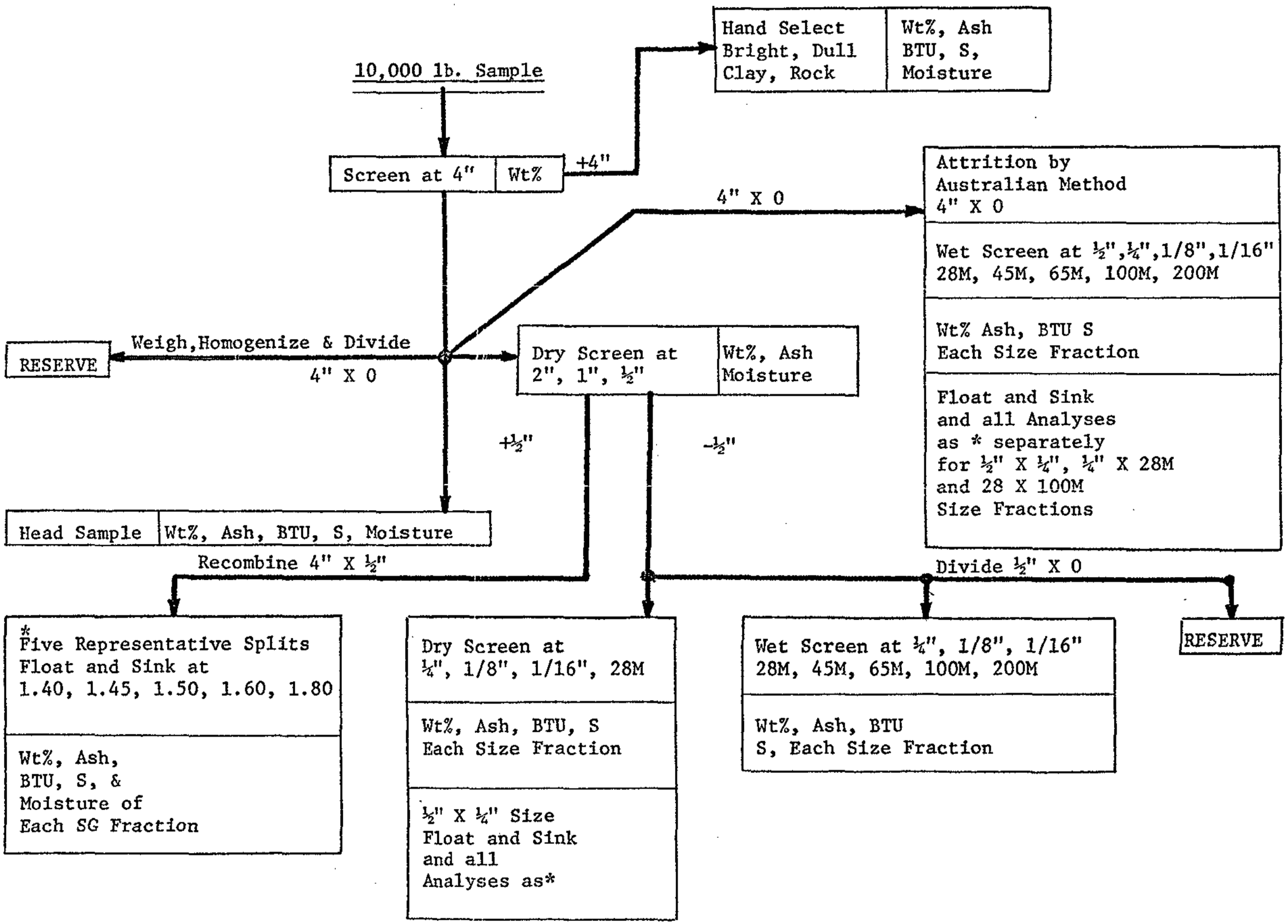
| Size mm | (in) | Normal Coal Weight % | Stored Coal Weight % |
|---|---|---|---|
| 50-25 | (2-1) | 10 | 7[1] |
| 25-13 | (1-1/2) | 16 | 15 |
| 13- 6 | (1/2-1/4) | 17 | 16 |
| 6- 3 | (1/4-1/8) | 15 | 15 |
| 3-1.5 | (1/8-1/16) | 13 | 10 |
| 1.5-0.6 | (1/16-1/40) | 14 | 12 |
| 0.6-0 | (1/40-0) | 15 | 25 |
| Total | | 100 | |

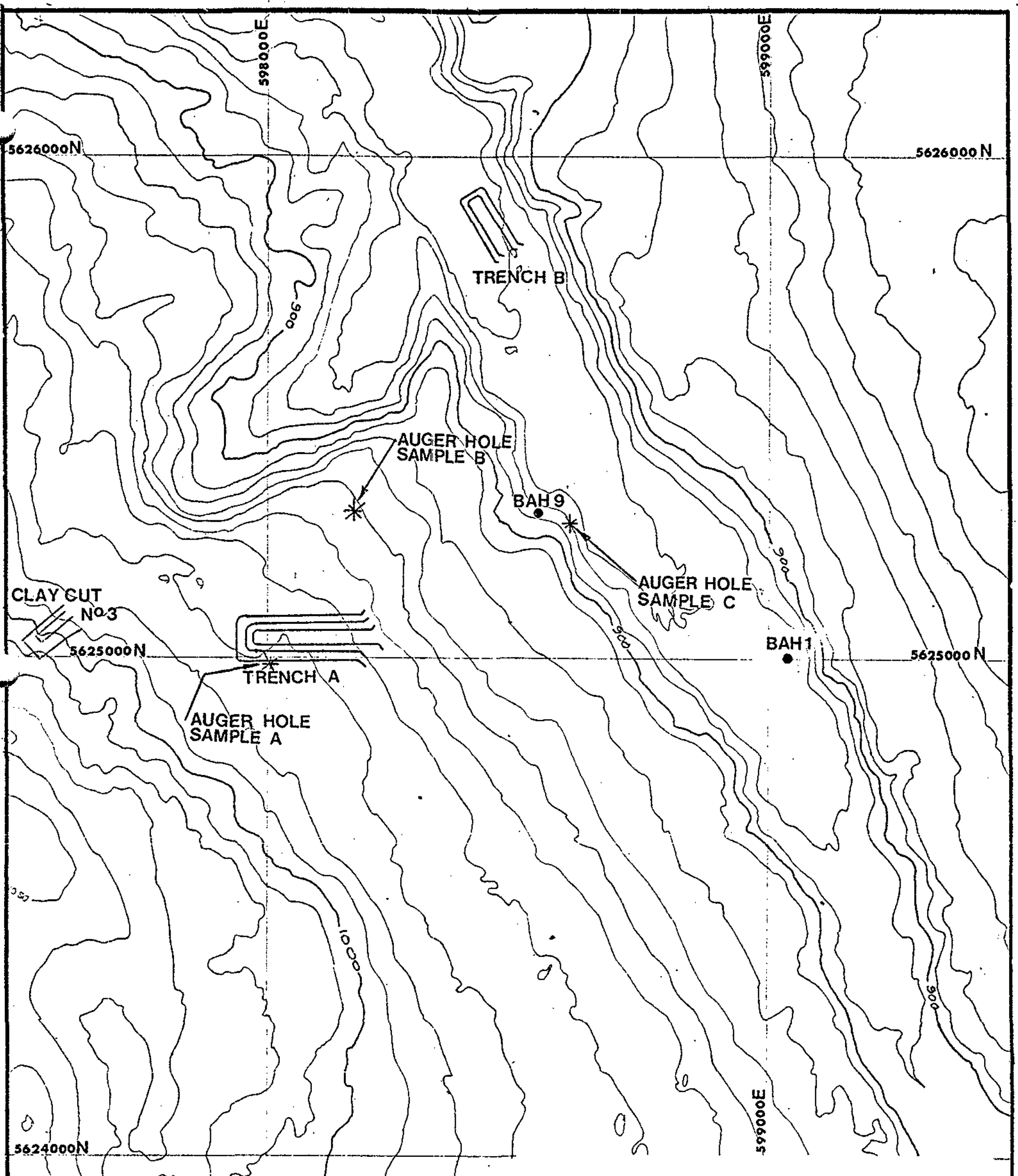
[1] Effective top size 40 mm (1 1/2 in) or less.

PLATE DZ-1

B. C. HYDRO - HAT CREEK PROJECT

SIZING AND WASHABILITY STUDIES FLOWSHEET






# HAT CREEK PROJECT

## SAMPLING SITE LOCATION PLAN

Scale 1=10 000

Date 1-9-78

PLATE D2-2

## SECTION D3.0 - COAL HANDLING

### D3.1 COAL HANDLING - BASIC PHILOSOPHY

The Hat Creek project coal handling system must ensure the fuel supply for production of reliable power from the proposed 2000 MW (net) coal-fired powerplant. The powerplant predicted lifetime operating regime is included in Appendix B. Base load operation is the intended fundamental method of operation but the powerplant and related facilities would have provision for producing power on a two-shift basis when necessary.

The basic philosophy behind the preliminary planning of the coal handling system for the overall project is therefore to provide the required power production fuel and, at the same time, ensure reasonable flexibility in operation of the mine and powerplant.

The following paragraphs describe the coal handling system for the project - the related waste handling systems are described in detail in the mining and powerplant appendices of this report. Environmental issues are described in Appendix E.

### D3.2 ESTABLISHED COAL HANDLING FACTORS

In reviewing the proposed project coal handling system certain factors are already established. These include:

1. Open pit No. 1, in the north end of the Hat Creek Valley, would be the source of all the coal for the proposed 2000 MW powerplant.

2. The powerplant would be located some 4 km (2.5 mi) east and some 500 m (1650 ft) higher than the surface level at Open pit No. 1.

D3.2 <u>ESTABLISHED COAL HANDLING FACTORS</u> - (Cont'd)

3. The Hat Creek climate extremes must be allowed for in design, recognizing the significant differences between conditions at the powerplant elevation and site, and the mine elevation and site.

4. Allowances must be made for the high ash content in the coal, and predominance of clay in the ash (particularly with regard to wet clay problems).

5. Coal processing and blending facilities would be located adjacent to, and operated as part of, the mine.

6. Although its production and production planning rates would be established by powerplant needs, the operation of and jurisdiction over the mine facilities may be different from that at the powerplant.

7. A reliable and promptly available lower sulphur coal supply must be assured to the boilers when necessary to meet the meteorological control system (MCS) requirements.

8. Run-of-mine coal to the blending system would be above 9.3 MJ/kg (4000 Btu/lb), dry basis.

9. Run-of-mine coal between 7.0 MJ/kg (3000 Btu/lb) and 9.3 MJ/kg (4000 Btu/lb) dry basis, would be stored in low quality coal storage piles for possible future use by processes other than the powerplant.

10. Normally all coal leaving the mining/blending/mixing area for delivery to the powerplant would be at or above the datum quality defined in Sub-section D2.6 of this Appendix. A tolerance down to the worst level coal of 16.3 MJ/kg (7000 Btu/lb) dry basis for temporary operation, would be designed for.

D3.2 ESTABLISHED COAL HANDLING FACTORS - (Cont'd)

11. The quantities of usable in-situ coal in Open pit No. 1 down to 265 m (870 ft) depth, and the proposed mining sequence are as described earlier in this Appendix and in Appendix A.

12. The overland conveyor, from the mining/blending area up to the end of flight 2 at the powerplant perimeter, would be part of the mining operation.

13. The annual quantities of datum coal required to meet the predicted powerplant operating regime are as shown in Table D3-1.

14. Considerable knowledge of Hat Creek coal characteristics has emerged from the sampling and testing programmes carried out so far and this knowledge should be applied to the proposed coal handling scheme.

## D3.3 PROJECT COAL FACILITIES - BASIC DESCRIPTION

The proposed project coal system can be divided into three distinct operational areas as shown on Plate D3-1.

1. Mining, processing, blending and storage in the mine facilities area.

2. Reclaim, quality control, loading and delivery, again in the mine facilities area.

3. Receiving, storage and handling at the powerplant.

Operations 1 and 2 are part of the mining work, upon which study work has been done by Cominco-Monenco Joint Venture (CMJV) and the Thermal Division's Mining Department. Operation 3, the powerplant receiving, storage and handling system, is part of Integ-Ebasco's work and that of the Thermal Division's Thermal Engineering Department.

D3.3 PROJECT COAL FACILITIES - BASIC DESCRIPTION - (Cont'd)

Descriptions of the three operations are set out below.

In the detailed engineering phase the equipment specifications for all parts of the project coal handling system would be correlated to provide uniformity of major components where possible.

For location of project coal system components the overall "Project Layout Map" is included in this Appendix (Plate D3-2).

## D3.4 COAL HANDLING SYSTEM - MINING

### (a) General

The mining operation, covering operations 1 and 2 on Plate D3-1 has based its planning upon power station coal needs, assuming delivery of the datum fuel quality described earlier in this Appendix.

The coal quantities required to be delivered to the powerplant are given in Table D3- 1. Dilution and other loss allowances are described Sub-section D2.3 of this Appendix, and in Appendix A.

### (b) Summary of Components

The proposed mining plan is fully described in Appendix A. For convenient reference in relation to project coal handling the basic coal operations in the mining operation are summarized as follows:

(i) Operation 1 - Mining, Processing, Blending and Storage

1. Shovels at coal face.

2. Haulage trucks - coal face to dump pockets.

D3.4 COAL HANDLING SYSTEM - MINING - (Cont'd)

3. Truck unloading station.

4. Mine conveyor system.

5. Coal secondary crushing system.

6. Coal sampling.

7. Blending/storage pile construction system.

(ii) Operation 2 - Reclaim, Quality Control, Loading, Delivery

1. Reclaimers from the blending piles.

2. Facilities for loading the overland conveyor, including sampling and quality control to ensure shipment of datum coal. This facility would include provision to add good quality coal from the D zone of the mine into the blended pile product if and when necessary.

3. The overland conveyor system which would carry coal to the powerplant perimeter.

Plate D3-1 shows these components and flow rates in basic diagram form.

Plate D3-3 is a schematic representation of operations 1 and 2 and other mining operations.

Plate D3-4 shows preliminary layouts of the truck unloading stations, primary crushers, and mine conveyors.

D3.4 COAL HANDLING SYSTEM - MINING - (Cont'd)

Plate D3-5 shows a preliminary layout of the coal preparation area.

Plate D3-6 shows a preliminary layout of the coal blending storage system.

Plate D3-7 shows preliminary layout details of the overland coal conveyors.

(c) Description of Components

The above components of the mining operation coal system are described below. These descriptions cover the basic concepts; details of each part of the coal system would be finalized later including safety devices, system interlocking, protection devices to remove tramp iron, winter condition provisions, etc.

(i) Shovels (Start of Operation 1)

Seven 16.8 $m^3$ (22 $yd^3$) electric shovels, backed by bulldozers and front-end loaders when necessary, would load coal into the haulage trucks at the planned production rate. Shovel capacity assessment for coal (and waste material) is detailed in Appendix A.

(ii) Haulage Trucks (Operation 1 continued)

Nine 109 t (120 ton) coal trucks for hauling coal to the dump pockets are proposed. (For moving waste material to the unloading station a fleet of eighteen 136 t (150 ton) trucks is proposed and, in addition, there would be smaller haulage trucks for other duties.)

D3.4 COAL HANDLING SYSTEM - MINING - (Cont'd)

(iii) Truck Unloading Station (Operation 1 continued)

Three unloading stations are proposed for the eventual full capacity mining operation. Located over the inclined in-pit conveyors at the northern end of the proposed mine, the stations would be built in sequence as the pit deepens. The first, near the surface would be installed during the pre-production phase, the second in year 5, approximately half-way down the incline and the third in year 20, at the bottom of the incline.

As shown in Plate D3-4 each unloading station would comprise a series of hoppers with each hopper structure divided into two outlet sections. Sizing of the hopper sections would be adequate to ensure smooth efficient unloading operation of the haulage trucks.

Each of the two hopper outlets would have a reciprocating feeder (tentatively with hydraulic drive) feeding run-of-mine coal into primary crushers.

(iv) Primary Crushers (Operation 1 continued)

Primary crushers with inlet screens, or with combined screening and crushing as tentatively proposed on Plate D3-4, would reduce run-of-mine coal to minus 300 mm (12 in) from the incoming minus 1200 mm (48 in).

The primary crushers would discharge on to the mine coal conveyors.

The type and size of primary crusher would be established later, with particular consideration of, and with further suitability tests for, the potential for clay separation in the crushing operation. The Siebra type screening/crushing arrangement shown on Plate D3-4 is tentative only.

(v) Mine Conveyor System (Operation 1 continued)

Belt conveyors would carry coal (and waste material) to the surface up the mine incline.

Three mine conveyors are proposed, two for waste material and one for coal, each being designed for 3200 t/h (3500 tons/hr) coal, or 5000 t/h (5500 tons/hr).

The mine conveyors, with a maximum slope angle of $14^{\circ}$, would be open type.

As shown schematically on Plates D3-3 and D3-5 transfer conveyors would carry coal from the top of the incline to the crushing plant.

Tables D3-2 and D3-3 give tentative details of mine and transfer conveyors, including those for waste material.

(vi) Secondary Crushing System (Operation 1 continued)

A crusher house structure, near the top of the mine incline, would receive minus 300 mm (12 in) run-of-mine coal and crush it to minus 50 mm (2 in x 0) for onward delivery to the blending/storage piles.

The proposed secondary crusher throughput is 3200 t/h (3500 tons/hr). The crusher house would also include surge hoppers, feeders and screens.

D3.4 COAL HANDLING SYSTEM - MINING - (Cont'd)

The final number, size and type of secondary crusher would be determined later. Tentatively, three impact type crushers are envisaged, each of which could handle 3200 t/h (3500 tons/hr). Particular study of screen and crusher designs suitable for the bentonitic clay which must be handled would be carried out later.

Crushed coal would be carried by transfer conveyors from the crusher house to the blending/storage piles.

(vii) Blending/Storage Piles (Operation 1 continued)

Plate D3-6 gives a preliminary indication of a possible layout of the piles which would comprise two regular blending piles each of 280 000 t (310,000 tons) capacity, two high-grade coal piles, each of 135 000 t (150,000 tons) capacity, and space for an emergency stockpile of up to 280 000 t (310,000 tons) which could be used in various ways.

The blending/storage piles would receive crushed varying run-of-mine coals from the secondary crusher house at minus 50 mm (2 in x 0).

The quality of the incoming coal would vary from the mine cutoff grade 9.3 MJ/kg of (4000 Btu/lb) dry basis, up to around 2.2 MJ/kg (9500 Btu/lb) dry basis, which is typical of the good quality coal from D zone, i.e. the high-grade coal shown on Plate D3-6.

Normally all coal arriving from the mine and crusher house would pass through the blending/storage system; there would be a provision for a bypass for use under certain circumstances.

D3.4 COAL HANDLING SYSTEM - MINING - (Cont'd)

Each regular blending pile would have approximately 7 days' powerplant consumption of datum coal at full load. One of these piles would be built up while the other one was being drawn down for powerplant consumption.

Incoming coal would be stocked out by the windrow method in the regular blending pile with a preplanned distribution to suit incoming coal quality and the production of a resultant uniform product which would be up to at least datum coal quality for the powerplant.

Each of the high-grade blending piles shown on Plate D3- 6 would be high-grade coal only, i.e. lower sulphur coal from D zone. Each high-grade pile is about 135 000 t (150,000 tons) capacity. These piles would be used, when necessary, to provide coal for mixing with the product from the regular blending pile in order to attain datum quality. Also, at certain times, the powerplant may call for direct delivery of high-grade lower sulphur coal in order to replenish its stocks for temporary air quality control purposes.

Space has been allowed, and provision made, for an emergency stockpile adjacent to the blending/storage area. The emergency stockpile would normally be empty and would not have stocking-out or reclaiming equipment of its own. This area would be used for dealing with surges in quality or quantity from the mining/crushing operations, when necessary. It also would give provision for improving coal quality by further blending in the stockpile area.

Two travelling stackers would service the blending/storage area, one for the two regular blending piles and one for the two high-grade blending piles. The stackers would be of the slewing type suitable for stocking out coal on a windrow method. Each stacker would have a maximum capacity of 3200 t/h (3500 tons/hr).

The stacker, in each case, would transfer from one pile to the other when the piles are ready to be switched from build-up to draw-down and vice versa.

Should the emergency stockpile come into use, the stacker from the high-grade blending pile would be temporarily switched to serve that area.

The ratio of pile crest length to pile base width, in all cases, would be 10:1. Base width would be the same in all cases to allow interchangeability of the reclaimers and stackers.

Normally the blending/storage piles would not be compacted. Provision would be made for providing compaction if this should prove necessary for short periods. Provision would also be made to deal with heating and local spontaneous combustion in the uncompacted piles. If the high-grade stockpile, which may be left for longer periods in the blending/storage area, proves to be little used, compaction could be applied to that pile. The high-grade pile would be maintained at a size compatible with powerplant demand and the incoming coal quality,during the varying production phases of the mine.

D3.4 COAL HANDLING SYSTEM - MINING - (Cont'd)

(viii) Operation 1 - Summary

The crushing, screening and blending/storage of run-of-mine coal, as above, completes the description of operation 1 in the project coal handling system.

Operation 1 would have reasonable flexibility for efficient and convenient operation in maintaining the blending stockpile capacities in accordance with the planned production schedules.

Study is continuing on the possibility of beneficiating some of the raw coal:

1. To bring poor quality coal up to a grade where it could be included in the blend for the powerplant.

2. As a possible additional up-grading facility for some of the powerplant coal should this prove necessary, e.g. if the overall quality is falling below datum level.

Plate D3-3 shows in dotted lines the potential position of a wash plant and how it would fit in with operation 1.

(ix) Reclaimers/Loading/Delivery (Operation 2)

Operation 2 of the overall project coal handling system covers the despatch of a suitable quality product from the mining operation. Powerplant datum coal would be provided from the regular blending pile currently being drawn down, with addition of good coal from the high-grade blending pile as and when necessary.

D3.4 COAL HANDLING SYSTEM - MINING - (Cont'd)

Continuous sampling of the input to the blending pile and the final product sent to the powerplant would provide the necessary quality control. A tentative schematic layout is shown on Plate D3-3 and a tentative arrangement on Plates D3-5 and D3-6 for the reclaiming/mixing/despatch facilities.

Two bridge-type bucket wheel travelling reclaimers would be provided. One would work on the regular blending pile (draw down) and one on the high-grade pile (provide good coal). The reclaimer on the regular pile would switch to the other regular pile when the piles were being reversed and, should the emergency stockpile have to be used, the reclaimer from the high-grade pile would be temporarily used for emergency reclaim from it.

The blending/reclaiming/mixing facilities are part of the mining operation and control of the power-plant fuel quality would be the responsibility of the mine. The quality of coal to be despatched has been established at the datum level with a specified tolerance. The maximum, and average, annual quantities have been tentatively assessed. The actual quantities to be planned for, and despatched, would be advised to the mining operation in advance, and be in accordance with the planned powerplant production schedule. The powerplant's forecasted consumption would be the basic operating parameter for the reclaiming, mixing and quality control in operation 2.

Each reclaimer would be of maximum capacity 3200 t/h (3500 tons/hr). Normal maximum flow to the powerplant would be 2500 t/h (2750 tons/hr) based upon an 18 hr out of a 24 hr operating period for filling the powerplant silos. When necessary the reclaim/mixing/despatch facilities could be operated at up to 3000 t/h (3300 tons/hr) using two reclaimers.

(x) Overland Conveyor (Operation 2 continued)

A single conveyor line comprising two flights, would carry coal from the blending/storage/reclaim area to the perimeter of the powerplant. The conveyor would be of normal maximum capacity 2500 t/h (2750 tons/hr) based upon an 18 hr silo filling sequence with four units at full load in the powerplant. The maximum capacity of the overland conveyor, however, would be 3000 t/h (3300 tons/hr) to allow for overdelivery of coal when necessary, e.g. when replenishing powerplant stockpiles as well as delivering full load silo filling quantity.

The overland conveyor concepts are shown on Plate D3-7. The conveyor would be mounted near ground level with cut and fill sections to suit the land contours. It would pass underneath the project access road where necessary. A 5 m wide road allowance would be included alongside the conveyor.

The conveyor would be covered and, in certain areas, a totally enclosed gallery may be used, e.g. where deep snowdrifts can occur. Fire protection, dust control and other conveyor features would be determined in the detailed design stage. Controls and interlocking would also be engineered later.

The first flight of the overland conveyor would end at a transfer house some 2100 m (6900 ft) from, and 270 m (890 ft) above, the blending/storage area, as shown on Plate D3-7. The drive for the first flight would be at this transfer house.

The second flight would be approximately 1900 m (6200 ft) long with a lift of 250 m (820 ft) and would end at a transfer point at the powerplant perimeter. The drive for the second flight would be at this transfer point.

Drive power, in each case, would be around 3000 kW (4000 hp).

Careful study of the required number of overland conveyor belts has been carried out. However, the risk of loss of coal supply with even a multiplicity of overland conveyor belts necessitates the provision of adequate storage of coal at the powerplant to ensure that power production requirements would be met at all times. On this basis, a single overland conveyor has been selected.

Table D3-4 provides preliminary details of the main overland conveyor's two flights.

The reclaiming, mixing, quality control, and delivery by overland conveyor to the powerplant as above completes the description of operation 2 of the project coal handling system.

## D3.5 COAL HANDLING SYSTEM - POWERPLANT (Operation 3)

### (a) General

The powerplant coal system (operation 3 on Plate D3-1) includes:

1. Facility for receiving the discharge from the overland conveyor system.

2. A silo filling system to deliver coal to the silos above the pulverizers from the overland conveyor or from powerplant storage.

3. Powerplant storage facilities.

Powerplant coal-related design data, including coal requirements are assembled in the Station Design Manual (SDM) compiled by the powerplant consultant Integ-Ebasco.

The powerplant coal system is designed to provide coal quantity, of specified datum quality, to meet the predicted operating regime.

In 18 hrs the silo filling system would provide the datum coal required by four units at full load for 24 hrs.

### (b) Summary of Components

The main components of the powerplant coal handling system are:

1. Conveyor from the overland conveyor terminal point at the powerplant perimeter to the main powerplant transfer house.

2. Main transfer house, including crushers for frozen coal.

D3.5 COAL HANDLING SYSTEM - POWERPLANT - (Cont'd)

3. Conveyors from main transfer house to surge bins 1 and 2.

4. Surge bins 1 and 2.

5. Feeders and conveyors for transfer from surge bins 1 and 2.

6. Silo conveyors.

7. Silos.

8. Stocking-out reclaiming conveyor.

9. Stocker-reclaimer and live storage facility.

10. Dead storage facility and mobile equipment - emergency reclaim facilities.

D3.5 COAL HANDLING SYSTEM - POWERPLANT - (Cont'd)

11. Powerplant coal handling control facilities.

12. Powerplant coal handling sampling/testing facilities.

Plate D3-1 shows the powerplant coal handling system diagrammatically as part of the overall project coal system.

Plate D3-8 shows the detailed coal handling diagram for the powerplant.

Preliminary coal handling layout major features are shown on the plot plan of the powerplant, Plate D3-9.

Detailed preliminary coal handling layouts at the powerplant are now in preparation.

D3.5 COAL HANDLING SYSTEM - POWERPLANT - (Cont'd)

(c) Description of Components

The above components of the powerplant coal handling system (operation 3) are described in more detail as follows:

(i) Receiving System Conveyor

Coal discharged from the second flight of the overland conveyor at the transfer point, just south of the powerplant fence, would transfer to conveyor No. 1 which would carry it to the main transfer house.

Conveyor No. 1, would be a single covered belt, above ground, and running north south on the east side of the cooling towers. As this conveyor would be in effect the third flight of the overland conveyor it would operate as part of the complete overland system. Maintenance of it, however, would be a powerplant responsibility. Should it be unavailable for any reason it would not preclude operation of the remainder of the powerplant coal handling system or affect the supply of fuel to the silos.

Suitable sampling facilities would monitor incoming coal quality at the discharge of conveyor No. 1.

Capacity of conveyor No. 1 would be:

| | |
|---|---|
| Normal maximum | 2500 t/h (2750 tons/hr) |
| Peak capacity | 3000 t/h (3300 tons/hr) |

Study would be made later on potential infra-red heating of coal on conveyor No. 1 to reduce surface moisture in which case this conveyor would be in an enclosed gallery.

(ii) Main Transfer House

This transfer house would be the main coal receiving and distribution point for the powerplant. It would contain a 600 t (660 ton) surge bin and transfer conveyors for normal delivery of coal to the powerplant silos or, when necessary, to the powerplant storage system.

Two 100 percent capacity frozen lump crushers, with variable speed inlet feeders would be included for recrushing frozen coal reclaimed from the storage areas in winter if and when necessary. Screens may be included ahead of the crushers after a full evaluation of crusher alternatives. Normally the crushers would be bypassed. Protective devices such as metal detectors would be provided.

The transfer house would be heated and include dust control and fire protection facilities, and may incorporate a coal handling control room and other facilities.

(iii) Conveyor Nos. 4A and 4B
(Transfer House to Surge Bins 1 and 2)

Two 2500 t/h (2750 ton/hr) inclined conveyors, housed in a common enclosed and heated gallery, would carry coal from the main transfer house up to surge bins 1 and 2 in the auxiliary bay. Conveyors 4A and 4B would enter the main building between boilers 1 and 2.

(iv) Surge Bins 1 and 2/Conveyors 5A and 5B

These would be located respectively between boilers 1 and 2 and boilers 3 and 4 in the auxiliary bay. Surge bin 1 would be fed directly from conveyors 4A and 4B. Surge bin 2 would be fed from conveyors 4A or 4B by two 2500 t/h (2750 ton/hr) transfer conveyors 5A and 5B. Normally the surge bins would be fed by one of the inclined conveyors 4A and 4B and one of the transfer conveyors 5A and 5B.

Each surge bin would be of 100 t (110 tons) capacity.

(v) Surge Bin Outlet Feeders/Conveyors 6A, 6B, 7A, 7B (Transfer from Surge Bins 1 and 2)

Discharge from surge bins 1 and 2 would be by variable speed discharge feeders and manually operated gates. The feeders supplying the adjacent silo conveyors would feed direct. Those supplying the outer silo conveyors would feed onto conveyors 6A, 6B, 7A and 7B.

Duplicate conveyors 6A, 6B, 7A and 7B each would have a capacity of 300 t/h (330 ton/hr).

(vi) Conveyors 10 A/B, 11 A/B, 12 A/B, 13 A/B (Silo Conveyors)

Over the row of four silos on each side of each boiler a single silo filling conveyor (10 A/B, 11 A/B, 12 A.B and 13 A/B) of capacity 300 t/h (330 tons/hr) each would deliver coal to a travelling tripper which would fill the silos.

Simultaneous filling of all rows of silos so that daily coal demand for full load boiler operations could be completed over an 18 hr out of a 24 hr time period, is tentatively planned as the operating mode. However, the system design is flexible and would allow continuous filling with varying boiler loads.

The silo filling operation would be automated to a reasonable degree but would be under constant supervision from the coal handling control panel from which the filling rate could be manually adjusted.

Key signals (eg. low silo level alarms) would be repeated in the boiler control panels.

(vii) Silos

Eight silos, four on each side, would be provided for each boiler. Each silo would feed one pulverizer. The silos would each hold up to 8 hrs capacity for one pulverizer at full load with datum coal. Normally seven mills would carry full load. Silos would be of circular construction with conical bottoms of stainless steel with a $78^{0}$ slope. Manual gates would be fitted at each silo outlet and provision would be made for emptying the silo contents in emergency.

The silo gates, downpipes, feeders and emergency emptying chutes would be part of the boiler contract.

(viii) Stocking-out Conveyor

A single 2500 t/h (2750 tons/hr) conveyor 18 would feed from the main transfer house to the live storage area. It would discharge to the stacker/reclaimer.

Conveyor 18 is tentatively of open type. Study would be made of enclosing this conveyor along with the live storage pile (see below).

(ix) Stacker/Reclaimer - Live Storage

The base scheme includes a live storage pile of up to 2 1/2 days' supply at full load (102 000 t, 112,000 tons) in two sections. This would ensure that the powerplant had coal of acceptable quality directly and promptly reclaimable to assure continuity of power production at all times, including short interruptions in the coal supply from the mine.

Lower sulphur coal would be stored at one end of the live pile in readiness for coal switching for the MCS system.

A travelling rail-mounted stacker/reclaimer would stack coal at up to 2500 t/h (2750 tons/hr) on to the live storage piles adjacent to the track.

The live storage piles would be reclaimed regularly to avoid spontaneous combustion problems.

Reclaim from the uncompacted live storage piles in the base scheme would be by the bucket wheel on the stacker/reclaimer. Alternatively a hopper type bottom reclaim system with ploughs may be used.

Study is proceeding on the merits of forming the live storage pile under a roof so that, for a reasonable period, the powerplant could directly reclaim dry coal regardless of recent or current adverse climatic conditions. Study is also proceeding on the possible cost savings and operational limitations of eliminating the live storage pile proposed for the powerplant.

(x) Dead Storage

Adjacent to the live storage area a compacted dead storage pile of up to about 30 days capacity at full station load (1 272 000 t, 1,399,000 tons) could be built. This would allow the powerplant to be self sufficient for a reasonable period if a major interruption in coal supply from the mine were to occur. The dead storage would be compacted to avoid spontaneous combustion. This storage would be built by mobile equipment taking coal from the live storage area.

Reclaim would be by mobile equipment to the live storage reclaimer or, if no live storage were included, by mobile equipment to a series of reclaim hoppers.

Emergency reclaim hoppers and conveyors would be included in either case.

The powerplant coal handling plant would be designed so that live or dead storage could be rebuilt following heavy usage, whilst also receiving coal and filling silos at the normal maximum rate. The supply system (operation 2) would have overload capacity of 3000 t/h (3300 tons/hr) for such occasions.

D3.5 COAL HANDLING SYSTEM - POWERPLANT - (Cont'd)

Part of the dead storage area would be stocked with lower sulphur coal required for MCS operation.

It is anticipated that, in addition to giving the powerplant operators an assured supply of coal at all times and rapid retrieval of lower sulphur coal, the live and dead storage facilities may also be used to ease temporary operating problems which may arise from difficult coal quality or other operational factors.

(xi) Other Powerplant Coal Handling System Features

Many items of detailed engineering related to the coal system would be done later, particularly after the major boiler and coal handling equipment were ordered.

Particularly important would be:

1. The finalization of the basic control and instrumentation scheme, including the necessary sampling and testing facilities.

2. Environmental protection (eg. dust control, noise control).

## D3.6 COAL SYSTEM OPERATION

(a) General

Detailed operating regimes for the components of the project coal system can only be finalized when engineering has advanced into the detailed stage. Some of the basic operation concepts, however, are as follows:

D3.6 COAL SYSTEM OPERATION - (Cont'd)

1. Power production for the next period of time (say 1 month) would be planned ahead.

2. The appropriate coal requirements would be scheduled and advised to both powerplant coal operators and to the mining operation.

3. Operation 1 (mining, processing and blending) would plan and construct blending pile A accordingly.

4. Operation 2 (reclaim, loading and delivery) would be planned accordingly, working from blending storage pile B.

5. Operation 2 (delivery to the powerplant) would normally be in accordance with the consumption and coal would be delivered direct from the overland conveyor to the boiler silos.

6. The scheduled production and subsequent deliveries would be of datum quality coal. Sampling and quality control facilities in operation 2 would control delivered quality. The powerplant would also be sampling quality of coal delivered to the silos.

7. There would be occasions when unexpected events cause imbalance between operation 3 in the powerplant and operation 1 and/or 2 at the mine.

   There would also be occasions when it was desirable to operate for reasonable periods without complete balance. Table D3-5 lists some of these conditions and how each area might then operate.

D3.6 <u>COAL SYSTEM OPERATION</u> - (Cont'd)

The basic operating philosophy is to allow operation 1, and to a lesser degree 2, at the mine, reasonable flexibility to ensure productive, efficient mining and blending operations without being too tightly tied to powerplant consumption.

The overriding concept in operation 3, the powerplant coal operations, would be to ensure reliability of power production with coal of adequate quantity and quality available at all times.

The provision of lower sulphur coal to meet the proposed MCS operations is one of the conditions listed on Table D3-5.

(b) <u>Powerplant Coal Control Panel</u>

A powerplant coal handling control panel would be the operating centre for the complete powerplant coal handling system. Included in the panel would be a mimic diagram of the complete powerplant coal system including the intake system from the overland conveyor. The powerplant coal operator would manage the filling of the silos each day from this control panel. Any reclaiming or stacking-out of coal at the powerplant would also be controlled from this point.

When necessary, the powerplant coal operator would contact operation 2 (reclaiming and loading of the overland conveyor) when timing of starts and stops, etc., for the routine delivery of coal was to be set.

Normally steady operation of operation 2 and the overland conveyor and of the powerplant silo filling system at the rate appropriate to powerplant consumption is envisaged. Start/stop operation of the overland conveyor would be avoided.

## D3.7 LOW-GRADE COAL FACILITIES

As explained earlier, only coal above a cut-off grade of 9.3 MJ/kg (4000 Btu/lb) dry basis, would be used to contribute to the powerplant blend. Coal between 7.0 and 9.3 MJ/kg (3000 and 4000 Btu/lb) would be delivered to low-grade storage piles for possible future use in processes other than the conventional powerplant.

It would be handled as shown schematically on Plate D3-5 and taken by truck to the low-grade storage pile.

Study is continuing on the possibility of upgrading this coal to powerplant quality in which case it would be moved to the secondary crushing plant and then to the coal preparation plant as shown dotted on Plate D3-3.

## D3.8 COAL SAMPLING

Throughout the coal handling operations described above, coal sampling facilities would be used to ensure reliable fuel supply, efficient use of the coal resource, and practical control and administration of all three basic operations in the mine, blending and mixing facility and powerplant.

Sampling locations may include:

1. In-situ coal - for production planning.

2. Run-of-mine - for blending pile control.

3. Reclaimed coal from blending piles - for coal quality control prior to despatch.

4. Loading point of overland conveyor.

D3.8 COAL SAMPLING - (Cont'd)

5. Powerplant intake - for powerplant operation planning and fuel administration.

6. Powerplant boiler coal feed - for day-by-day powerplant operation.

At this stage, little detailed work has been done on sampling equipment and related analysis facilities. Considerable work would be required to engineer sound practical sampling/analysis systems for coal consumption on this scale. Application of rapid, direct methods would be sought, eg. continuous stationary ash and moisture monitors for immediate indication of heating value.

TABLE D3-1

HAT CREEK PROJECT
(Ref. Table 4-1 of CMJV Mining Report, Vol. III)

DATUM COAL REQUIREMENTS AT POWERPLANT

| Year | Coal Required Tonnes x $10^6$ | (Tons x $10^6$) |
|---|---|---|
| -1 Pre-Production | 1.03 | (1.14) |
| 1 | 3.08 | (3.40) |
| 2 | 5.43 | (5.99) |
| 3 | 8.20 | (9.04) |
| 4 | 10.66 | (11.75) |
| 5 | 11.30 | (12.46) |
| 6 to 15 | 113.76 | (125.40) |
| 16 to 25 | 105.96 | (116.80) |
| 26 to 35 | 90.07 | (99.28) |
| | 349.49 | (385.26) |

TABLE D3-2

HAT CREEK PROJECT
MINING OPERATION
MINE CONVEYORS
PRELIMINARY DATA

| Description | Length m | Lift m | Width mm | Capacity t/h | Nominal Speed m/s | Calculated Power kW | (hp) | Installed Power kW | (hp) |
|---|---|---|---|---|---|---|---|---|---|
| (1st Dump Pocket) | | | | | | | | | |
| Mine Conv. No. M1-1 | 360 | 40 | 1200 | 5000 | 5 | 809 | (1085) | 820 | (1100) |
| Mine Conv. No. M1-2 | 360 | 40 | 1200 | 5000 | 5 | 809 | (1085) | 820 | (1100) |
| Mine Conv. No. M1-3 | 360 | 40 | 1200 | 5000 | 5 | 809 | (1085) | 820 | (1100) |
| Sub-Total: | 1080 | | | | | 2427 | (3255) | 2460 | (3300) |
| (2nd Dump Pocket) | | | | | | | | | |
| Mine Conv. No. M2-1 | 470 | 75 | 1200 | 5000 | 5 | 1398 | (1874) | 1490 | (2000) |
| Mine Conv. No. M2-2 | 470 | 75 | 1200 | 5000 | 5 | 1398 | (1874) | 1490 | (2000) |
| Mine Conv. No. M2-3 | 470 | 75 | 1200 | 5000 | 5 | 1398 | (1874) | 1490 | (2000) |
| Sub-Total: | 1410 | | | | | 4194 | (5622) | 4470 | (6000) |
| (3rd Dump Pocket) | | | | | | | | | |
| Mine Conv. No. M3-1 | 600 | 90 | 1200 | 5000 | 5 | 1774 | (2378) | 1790 | (2400) |
| Mine Conv. No. M3-2 | 600 | 90 | 1200 | 5000 | 5 | 1774 | (2378) | 1790 | (2400) |
| Mine Conv. No. M3-3 | 600 | 90 | 1200 | 5000 | 5 | 1774 | (2378) | 1790 | (2400) |
| Sub-Total: | 1800 | | | | | 5322 | (7134) | 5370 | (7200) |
| TOTAL | 4290 | | | | | 11943 | (16011) | 12300 | (16500) |

TABLE D3-3

HAT CREEK PROJECT
MINING OPERATION
SURFACE COAL TRANSFER CONVEYORS
PRELIMINARY DATA

| Description | Length m | Lift m | Width mm | Capacity t/h | Nominal Speed m/s | Calculated Power kW | (hp) | Installed Power kW | (hp) | Installation Year Yr |
|---|---|---|---|---|---|---|---|---|---|---|
| Transfer Conv. No. C1 to Crush Plant | 60 | 6 | 1200 | 3200 | 5 | 87 | (117) | 100 | (125) | -2 |
| Transfer Conv. No. C2 to Crush Plant | 115 | 24 | 1200 | 3200 | 5 | 231 | (309) | 250 | (350) | -2 |
| Transfer Coal Conv. No. C3 in Crush Plant | 40 | 6 | 1200 | 3200 | 5 | 77 | (103) | 100 | (125) | -2 |
| Transfer Conv. No. C4 to Blending Area | 70 | 6 | 1200 | 3200 | 5 | 92 | (123) | 100 | (125) | -2 |
| Transfer Conv. No. C5 to Blending Area | 70 | 6 | 1200 | 3200 | 5 | 92 | (123) | 100 | (125) | -2 |
| Yard Conv. No. C7 | 670 | 10 | 1200 | 3200 | 5 | 424 | (568) | 450 | (600) | -2 |
| Yard Conv. No. C8 | 670 | 10 | 1200 | 3200 | 5 | 424 | (568) | 450 | (600) | -2 |
| Collecting Conv. No. C11 | 220 | 6 | 1200 | 3200 | 4 | 131 | (175) | 150 | (200) | -2 |
| Sub-Total: | 1915 | | | | | 1558 | (2086) | 1700 | (2250) | |
| Transfer Conv. to Blending Area No. C6 | 135 | 6 | 1200 | 3200 | 5 | 124 | (166) | 150 | (200) | -1 |
| Yard Conv. No. C9 | 670 | 10 | 1200 | 3200 | 5 | 424 | (568) | 450 | (600) | -1 |
| Yard Conv. No. C10 | 570 | 6 | 1200 | 2500 | 4 | 336 | (451) | 375 | (500) | -1 |
| Sub-Total: | 1375 | | | | | 884 | (1185) | 975 | (1300) | |
| TOTAL | 3290 | | | | | 2442 | (3271) | 2675 | (3550) | |

TABLE D3-4

HAT CREEK PROJECT
MINING OPERATION
OVERLAND COAL CONVEYOR TO GENERATING STATION
PRELIMINARY DATA

| Description | Length m | Lift m | Width mm | Capacity t/h | Nominal Speed m/s | Calculated Power kW (hp) | Installed Power kW (hp) | Installation Year Yr |
|---|---|---|---|---|---|---|---|---|
| Overland Conv. No. OC1 | 2100 | 279 | 1200 | 2500 | 4 | 2680 (3952) | 3000 (4000) | -2 |
| Overland Conv. No. OC2 | 1900 | 250 | 1200 | 2500 | 4 | 2800 (3754) | 3000 (4000) | -2 |
| TOTAL | 4000 | 520 | | 2500 | | 5480 (7706) | 6000 (8000) | |

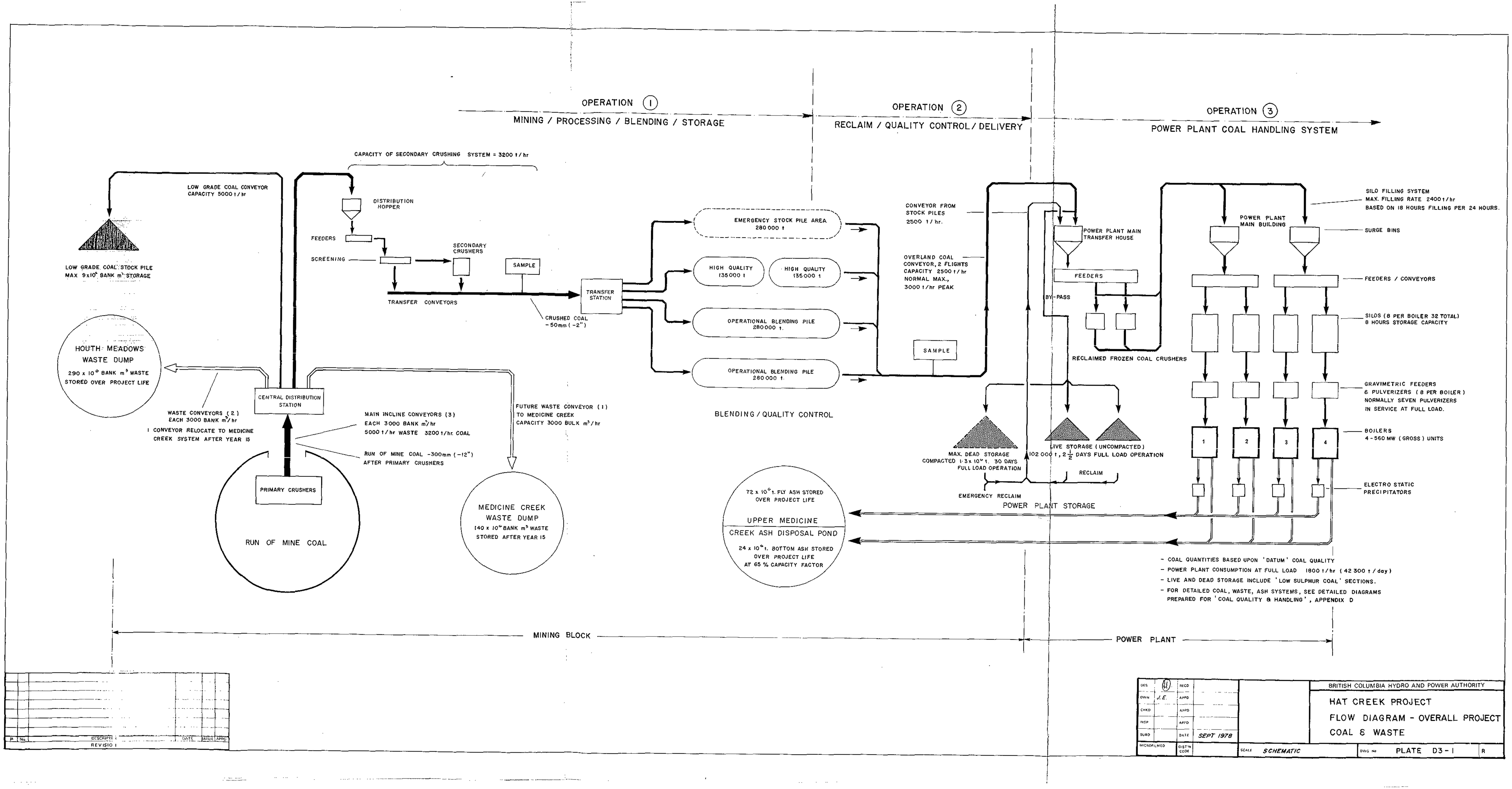
TABLE D3-5

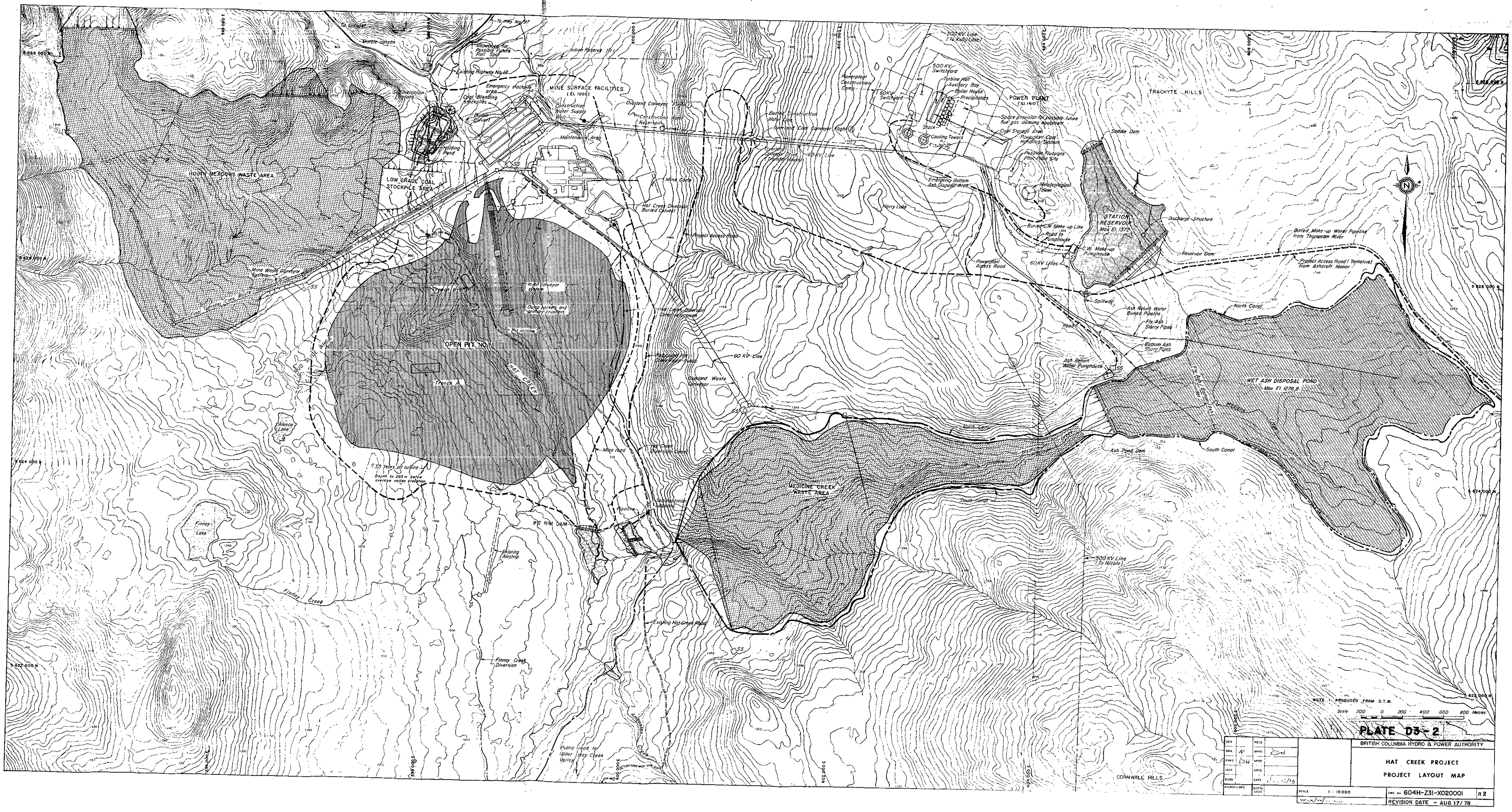
PROJECT COAL HANDLING SYSTEM
OPERATING REGIME - EXAMPLES OF VARIOUS OPERATING CONDITIONS

| OPERATING CONDITION | MINE | | POWERPLANT |
|---|---|---|---|
| | Operation 1 - Mining Processing Blending | Operation 2 - Reclaiming Loading Delivery | Operation 3 - Receiving & Handling to Boilers |
| Normal silo-filling four units at full load. (Power production maximum for current period of production.) | Mine and process coal to build blending pile "B" at a rate of 43 200 t/day. Hourly rate varies to suit mining operation. | Reclaim, load and deliver 2400 t/hr for 18 hours out of 24 from blending pile "A". | Receive and fill silos for 18 hours out of 24 at a rate of 2400 t/hr. |
| Normal silo-filling at 70 percent full load. (Power production 70 percent for current period of production.) | Mine and process coal to build blending pile "B" at a rate of 30 240 t/day. Hourly (or daily) rate varies to suit mining conditions. | Reclaim, load and deliver 2400 t/hr for 12 1/2 hours out of 24 from blending pile "A" (or 4 hr/shift). | Receive and fill silos for 12 1/2 hours out of 24 at a rate of 2400 t/hr (or 4 hr/shift). |
| Operations 1 and 2 lost temporarily. (Mine and blending, etc.) | Out | Out | Reclaim and fill silos for 18 hours out of 24 from storage at a rate of 2400 t/hr. (Maximum storage about 30 days at full load.) |
| Operation 3 lost temporarily. (All powerplant production.) | Continue to feed both blending piles until their capacity reached. Fill emergency blending pile. Then switch, if necessary, to waste material moving. | Cease delivery until powerplant calls for coal for silo-filling or storage. | Silo-filling ceases. If auxiliary power is functional silos can be filled and coal can be accepted to storage. |
| Mine over-producing temporarily. | Continue building blending piles to capacity. | Deliver at rate advised acceptable by powerplant. | Fill silos normally. Excess to powerplant storage. |
| Operation 2 under-producing temporarily. (Blending, loading and delivering) | Continue building blending piles to capacity. | Deliver at best rate possible. Restore planned rate as soon as possible. | Fill silos continuously with mine deliveries. Reclaim necessary quantity from storage to supplement. |
| Operation 1 under-producing temporarily. (Mine) | Restore planned rate as soon as possible. Continue to build blending pile at best rate possible. | Deliver at planned rate until blending piles used. | Continue normally unless shortfall of delivery occurs. Reclaim necessary quantity from storage to supplement. |
| Lower sulphur coal required for brief MCS operation. | No change | No immediate change. Plan deliveries based on revised daily instructions from powerplant. | Reclaim lower sulphur coal from live storage immediately and start filling silos of appropriate units. If necessary continue from dead storage. If necessary call for delivery of lower sulphur coal from operation 2. |

TABLE 3-5 - (Cont'd)

| | | | |
|---|---|---|---|
| Lower sulphur coal required for lengthy MCS operation. | No immediate change out plan to replenish lower sulphur pile in operation 2. | Load only lower sulphur coal until high grade stockpile exhausted. | Receive lower sulphur coal only from operation 2 to fill silos. |
| Rebuilding datum coal stockpile at powerplant after major period of non-delivery. | Mine at maximum rate to keep up with operation 2. | Deliver maximum rate powerplant can take from overland conveyor as long as powerplant can accept maximum flow. | Receive coal at maximum overland conveyor capacity (3000 t/hr) continuously. Excess coal to stockpile. Rebuild live and dead storage. Rebuilding live storage on this basis would take about 2 days even with four units at full load. Rebuilding dead storage would take up to 35 days on this basis. |
| Rebuilding lower sulphur stockpiles at powerplant while burning datum coal. | | Deliver datum coal for 18 hours out of 24. Deliver lower sulphur coal for 6 hours out of 24. | Datum coal to silos. Lower sulphur coal to storage. |


OPERATION (1)
MINING / PROCESSING / BLENDING / STORAGE
OPERATION (2)
RECLAIM / QUALITY CONTROL / DELIVERY
OPERATION (3)
POWER PLANT COAL HANDLING SYSTEM
CAPACITY OF SECONDARY CRUSHING SYSTEM = 3200 t / hr
LOW GRADE COAL CONVEYOR
CAPACITY 5000 t / hr
LOW GRADE COAL STOCK PILE
MAX 9x10⁶ BANK m³ STORAGE
DISTRIBUTION HOPPER
FEEDERS
SCREENING
SECONDARY CRUSHERS
SAMPLE
TRANSFER CONVEYORS
TRANSFER STATION
CRUSHED COAL
-50mm (-2")
HOUTH MEADOWS WASTE DUMP
290 x 10⁶ BANK m³ WASTE
STORED OVER PROJECT LIFE
WASTE CONVEYORS (2)
EACH 3000 BANK m³/hr
1 CONVEYOR RELOCATE TO MEDICINE CREEK SYSTEM AFTER YEAR 15
CENTRAL DISTRIBUTION STATION
MAIN INCLINE CONVEYORS (3)
EACH 3000 BANK m³/hr
5000 t / hr WASTE 3200 t/hr. COAL
RUN OF MINE COAL -300mm (-12")
AFTER PRIMARY CRUSHERS
PRIMARY CRUSHERS
RUN OF MINE COAL
FUTURE WASTE CONVEYOR (1)
TO MEDICINE CREEK
CAPACITY 3000 BULK m³/hr
MEDICINE CREEK WASTE DUMP
140 x 10⁶ BANK m³ WASTE
STORED AFTER YEAR 15
EMERGENCY STOCK PILE AREA
280 000 t
HIGH QUALITY
135 000 t
HIGH QUALITY
135 000 t
OPERATIONAL BLENDING PILE
280 000 t.
OPERATIONAL BLENDING PILE
280 000 t.
BLENDING / QUALITY CONTROL
CONVEYOR FROM STOCK PILES
2500 t / hr.
OVERLAND COAL CONVEYOR, 2 FLIGHTS
CAPACITY 2500 t / hr
NORMAL MAX.,
3000 t / hr PEAK
SAMPLE
BY-PASS
POWER PLANT MAIN TRANSFER HOUSE
FEEDERS
RECLAIMED FROZEN COAL CRUSHERS
MAX. DEAD STORAGE
COMPACTED 1·3 x 10⁶ t. 30 DAYS
FULL LOAD OPERATION
LIVE STORAGE (UNCOMPACTED)
102 000 t, 2 1/2 DAYS FULL LOAD OPERATION
RECLAIM
EMERGENCY RECLAIM
POWER PLANT STORAGE
72 x 10⁶ t. FLY ASH STORED
OVER PROJECT LIFE
UPPER MEDICINE
CREEK ASH DISPOSAL POND
24 x 10⁶ t. BOTTOM ASH STORED
OVER PROJECT LIFE
AT 65 % CAPACITY FACTOR
POWER PLANT MAIN BUILDING
SILO FILLING SYSTEM
MAX. FILLING RATE 2400 t / hr
BASED ON 18 HOURS FILLING PER 24 HOURS.
SURGE BINS
FEEDERS / CONVEYORS
SILOS (8 PER BOILER 32 TOTAL)
8 HOURS STORAGE CAPACITY
GRAVIMETRIC FEEDERS
& PULVERIZERS (8 PER BOILER)
NORMALLY SEVEN PULVERIZERS
IN SERVICE AT FULL LOAD.
BOILERS
4 - 560 MW (GROSS) UNITS
1
2
3
4
ELECTRO STATIC PRECIPITATORS
- COAL QUANTITIES BASED UPON 'DATUM' COAL QUALITY
- POWER PLANT CONSUMPTION AT FULL LOAD 1800 t / hr (42 300 t / day)
- LIVE AND DEAD STORAGE INCLUDE 'LOW SULPHUR COAL' SECTIONS.
- FOR DETAILED COAL, WASTE, ASH SYSTEMS, SEE DETAILED DIAGRAMS PREPARED FOR 'COAL QUALITY & HANDLING', APPENDIX D
MINING BLOCK
POWER PLANT
No.
DESCRIPTION
REVISION
DATE
DES
DWN J.E.
CHKD
INSP
SUBD
RECD
APPD
DATE SEPT 1978
MICROFILMED
DIST'N CODE
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
FLOW DIAGRAM - OVERALL PROJECT
COAL & WASTE
SCALE SCHEMATIC
DWG No PLATE D3 - 1
R



HOUTH MEADOWS WASTE AREA
LOW GRADE COAL STOCKPILE AREA
MINE SURFACE FACILITIES
(EL 1000)
POWER PLANT
500 KV Switchyard
TRACHYTE HILLS
STATION RESERVOIR
Max El. 1372
Saddle Dam
Discharge Structure
Reservoir Dam
OPEN PIT NO. 1
HAT CREEK
Trench A
Harry Lake
Project Access Road
Overland Waste Conveyor
60 KV Line
Existing Highway No. 12
WET ASH DISPOSAL POND
Max El. 1278.8
North Canal
South Canal
Ash Pond Dam
MEDICINE CREEK WASTE AREA
PIT RIM DAM
Finney Lake
Finney Creek
Finney Creek Diversion
Existing Airstrip
Existing Hat Creek Road
Public road to Upper Hat Creek Valley
500 KV Line (To Nicola)
CORNWALL HILLS
NOTE: PRODUCED FROM D.T.M.
Scale 200 0 200 400 600 800 Metres
PLATE D3-2
BRITISH COLUMBIA HYDRO & POWER AUTHORITY
HAT CREEK PROJECT
PROJECT LAYOUT MAP
SCALE 1 : 10000
DWG No 604H-Z31-X020001
R 2
REVISION DATE - AUG 17/78

cominco-monenco joint venture

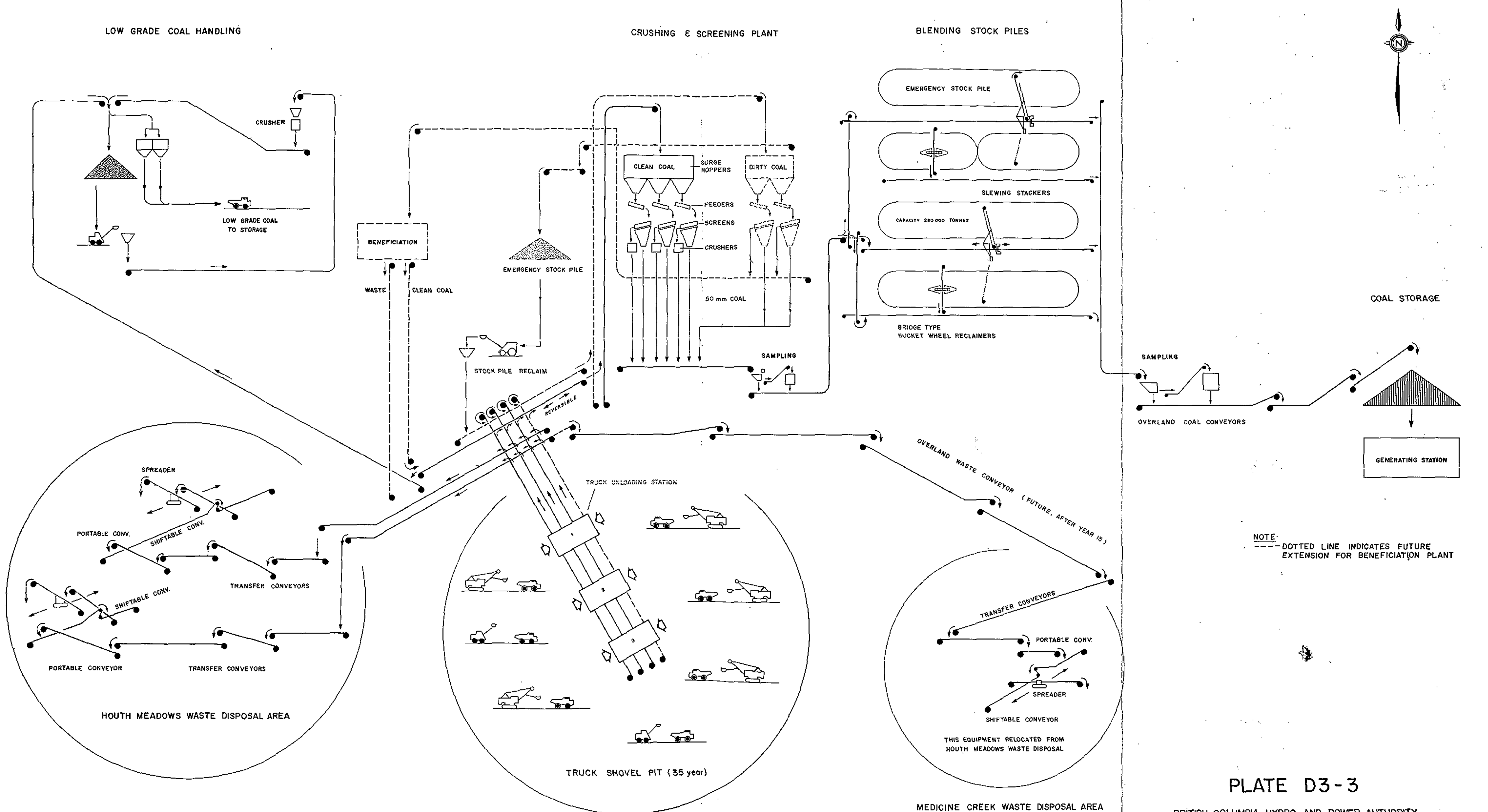


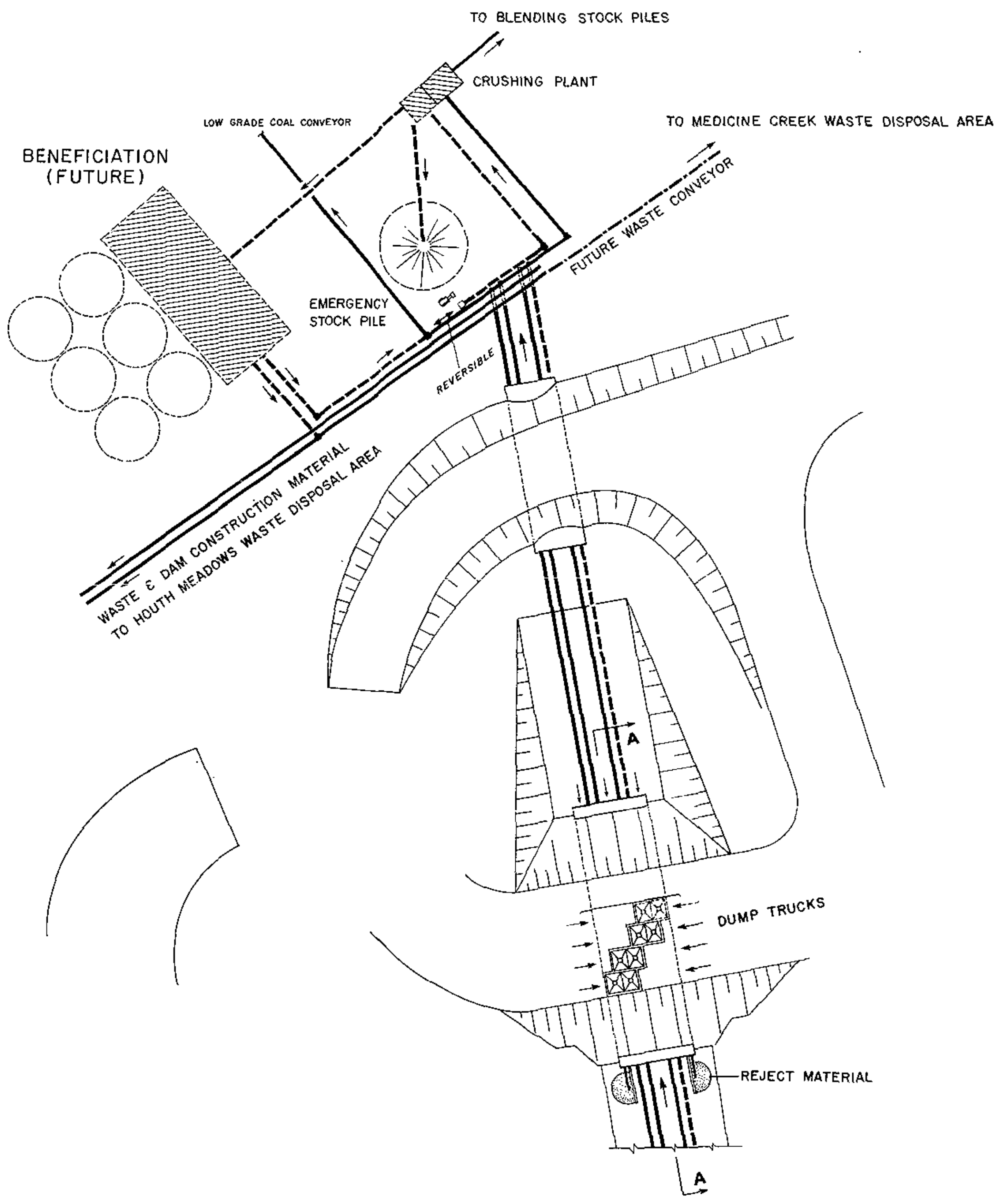

PLATE D3-3

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

SYSTEM FLOW SHEET

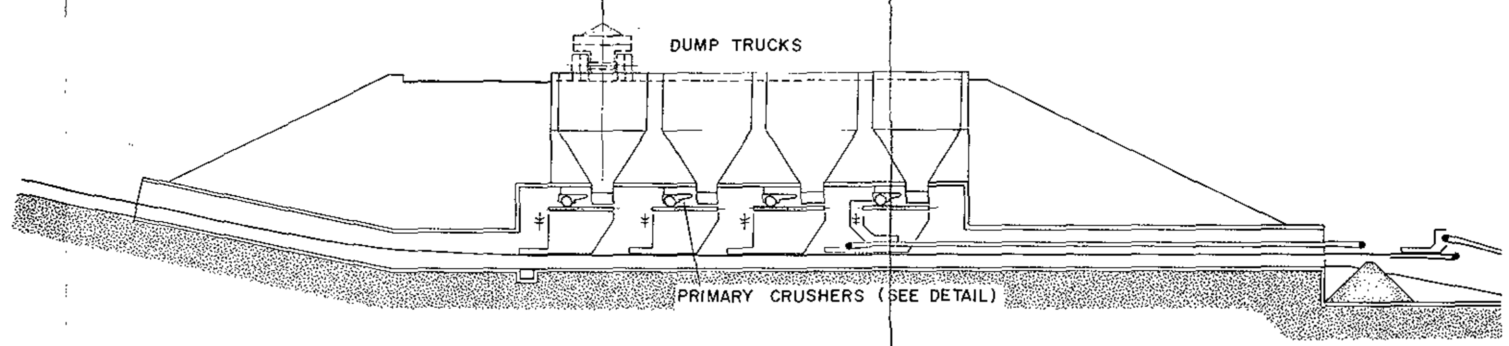
cominco-monenco joint venture

monenco



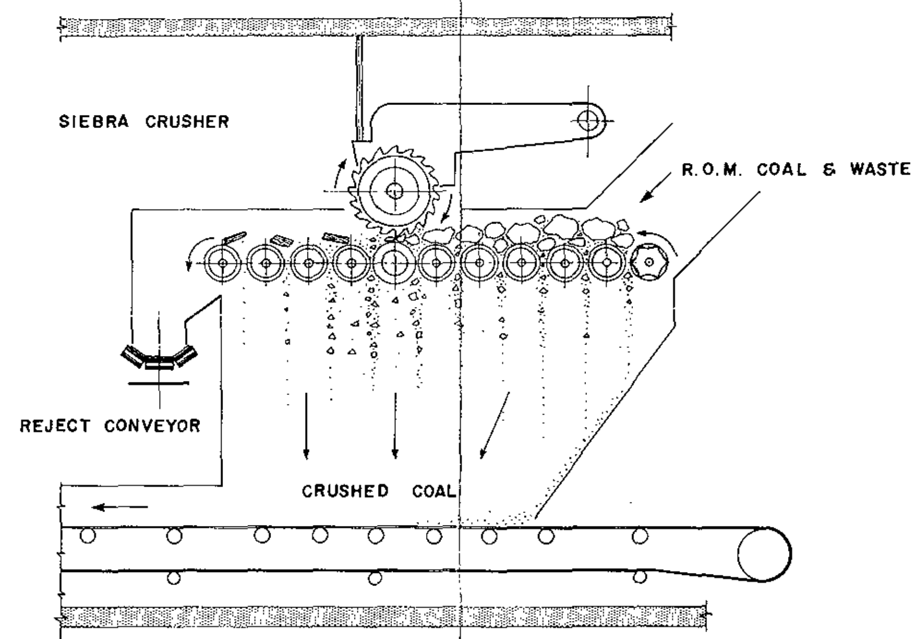

PLAN - TRUCK UNLOADING STATION & MINE CONVEYORS

20 0 20 40 60 80 m




SECTION A-A

5 0 5 10 15 20 25 m




DETAIL OF PRIMARY CRUSHING OPERATION (NOT TO SCALE)

NOTE
---- DOTTED LINE INDICATES FUTURE EXTENSION FOR BENEFICIATION PLANT

PLATE D3-4

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

TRUCK UNLOADING STATIONS AND DISTRIBUTION AREA

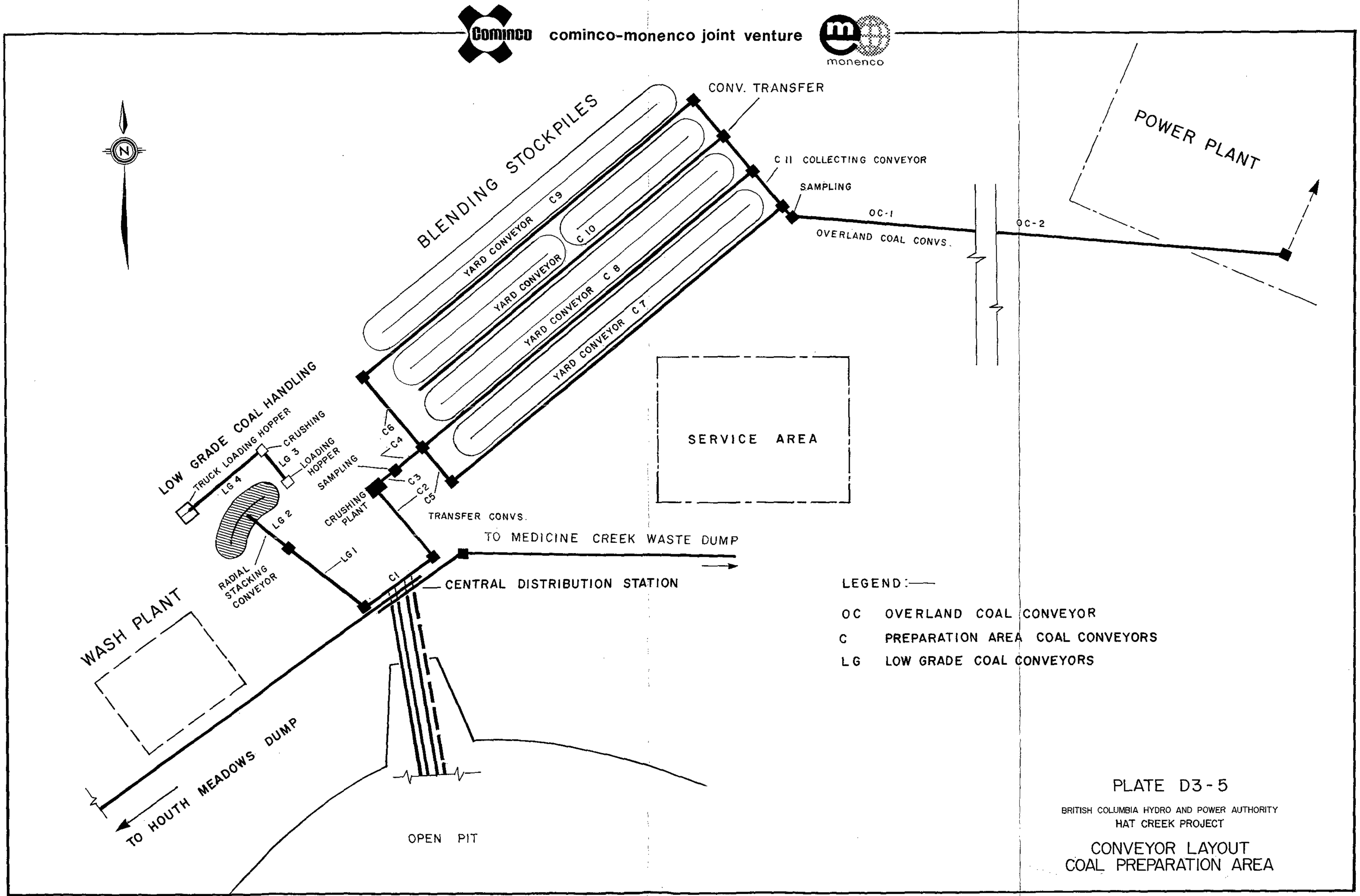


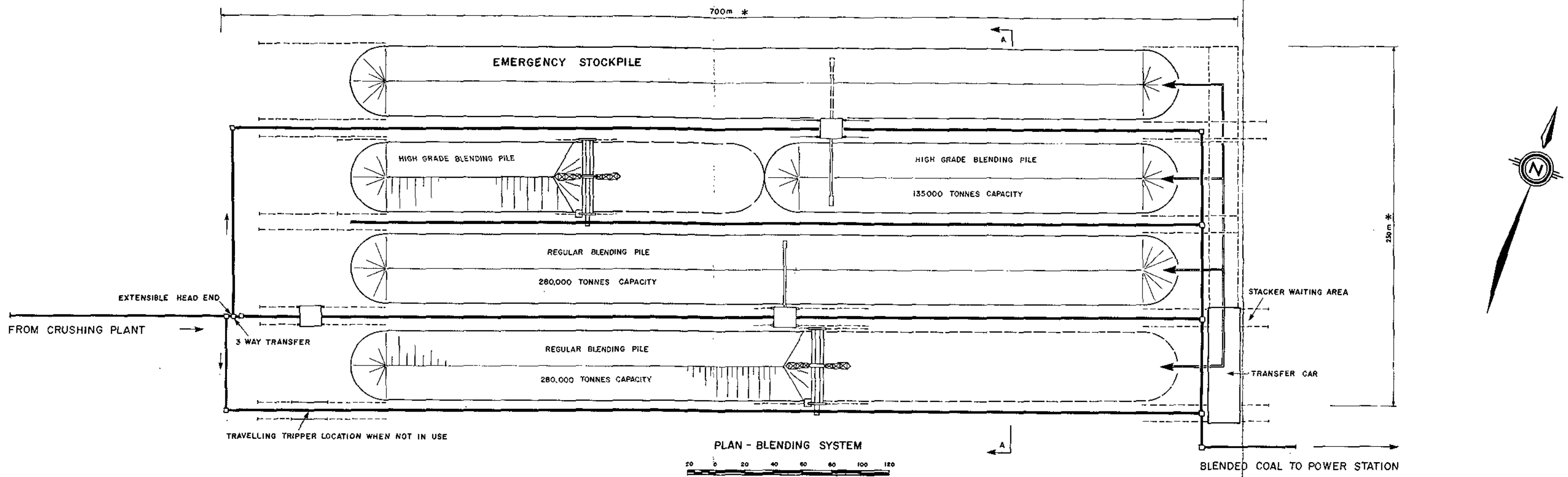

PLATE D3-5

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

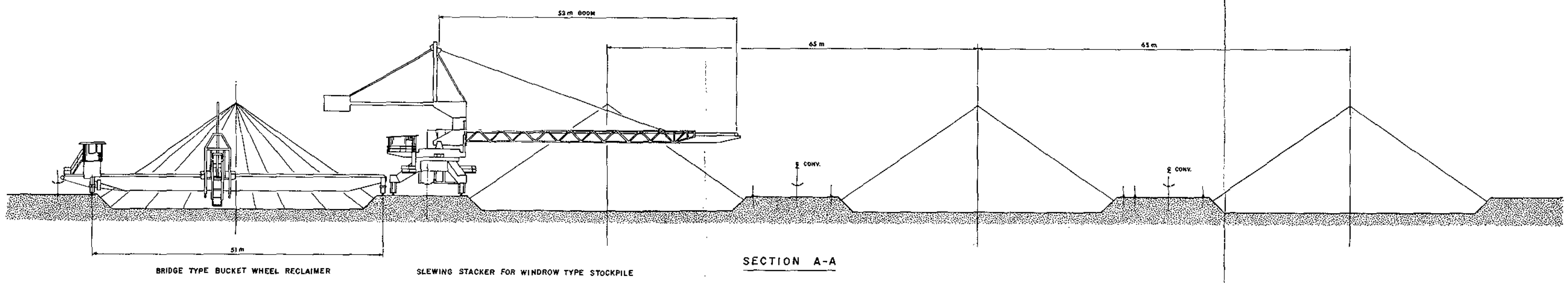
CONVEYOR LAYOUT
COAL PREPARATION AREA

cominco-monenco joint venture

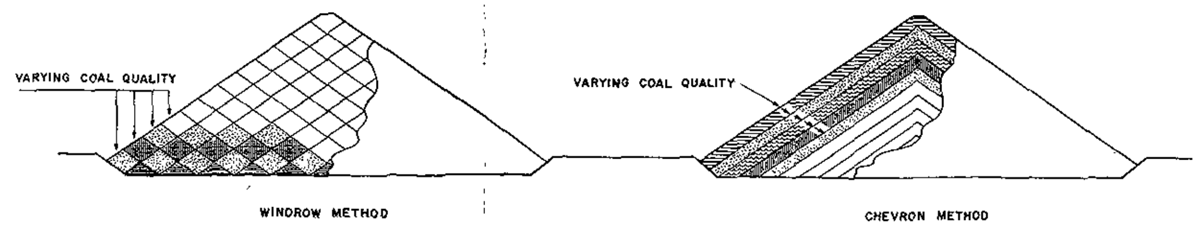
monenco




PLAN - BLENDING SYSTEM




SECTION A-A




SECTION - ALTERNATIVE STOCKPILES

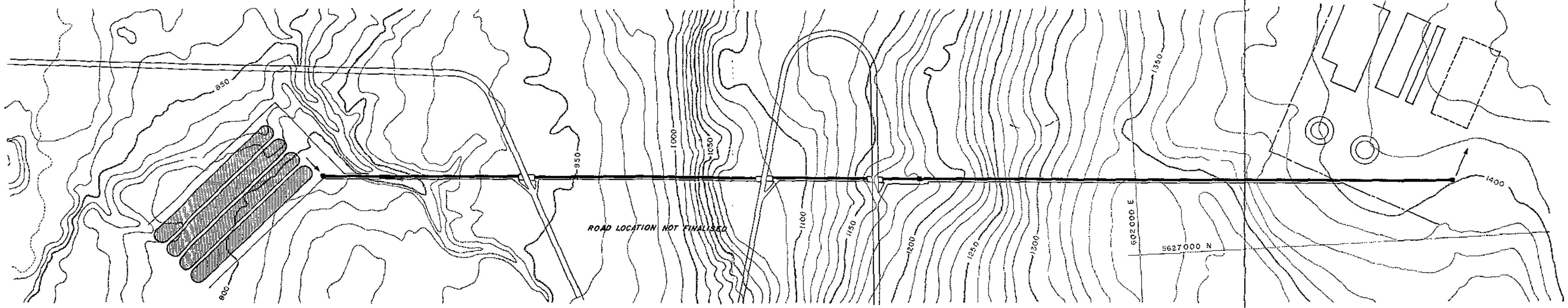
* APPROXIMATE AREA DIMENSIONS

PLATE D3-6

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

GENERAL ARRANGEMENT
COAL BLENDING SYSTEM

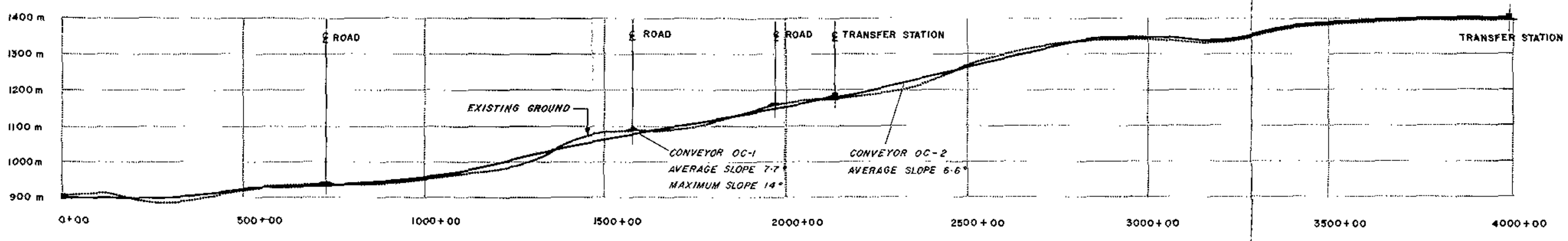
Cominco cominco-monenco joint venture monenco



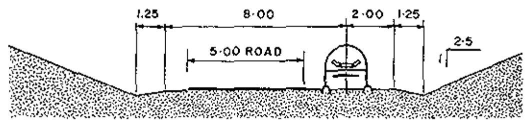

BLENDING STOCKPILES

POWER PLANT

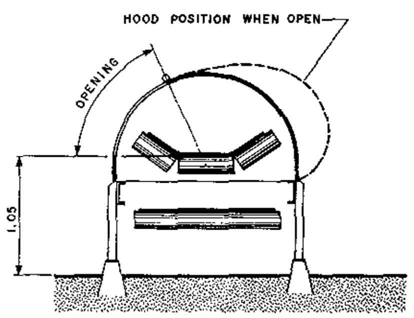
PLAN - OVERLAND COAL CONVEYOR



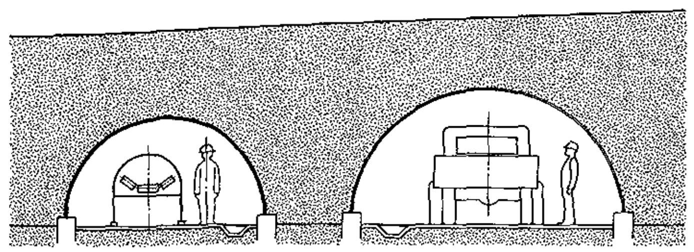

PROFILE - CONVEYOR ℄



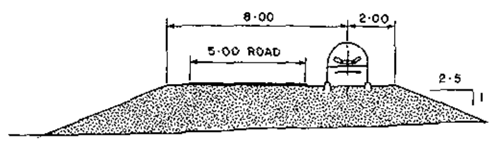

TYPICAL SECTION - CUT




TYPICAL SECTION - COAL CONVEYOR



SECTION - HIGHWAY OVERPASS

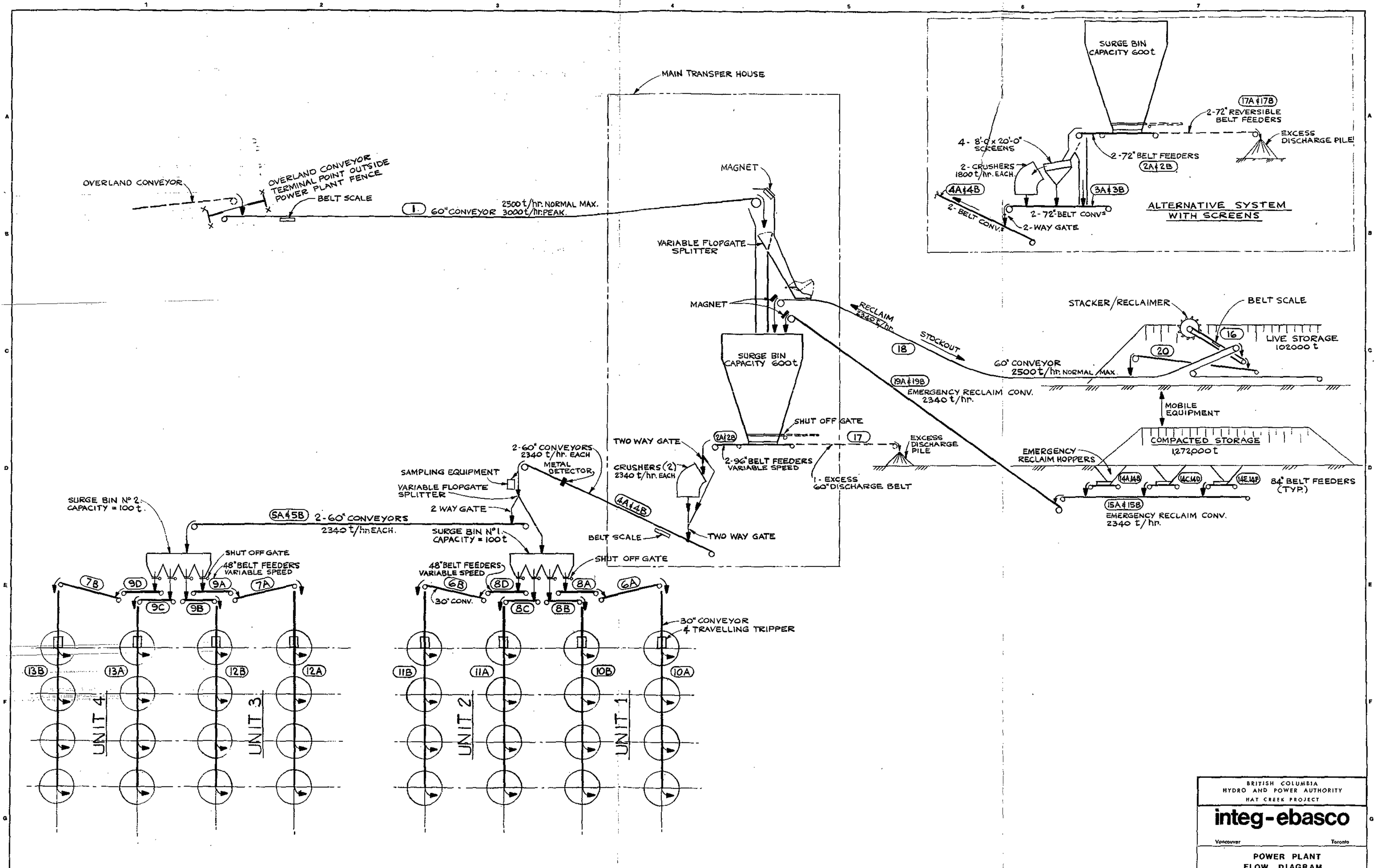



TYPICAL SECTION - FILL

PLATE D3-7

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

OVERLAND COAL CONVEYORS




BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

integ-ebasco

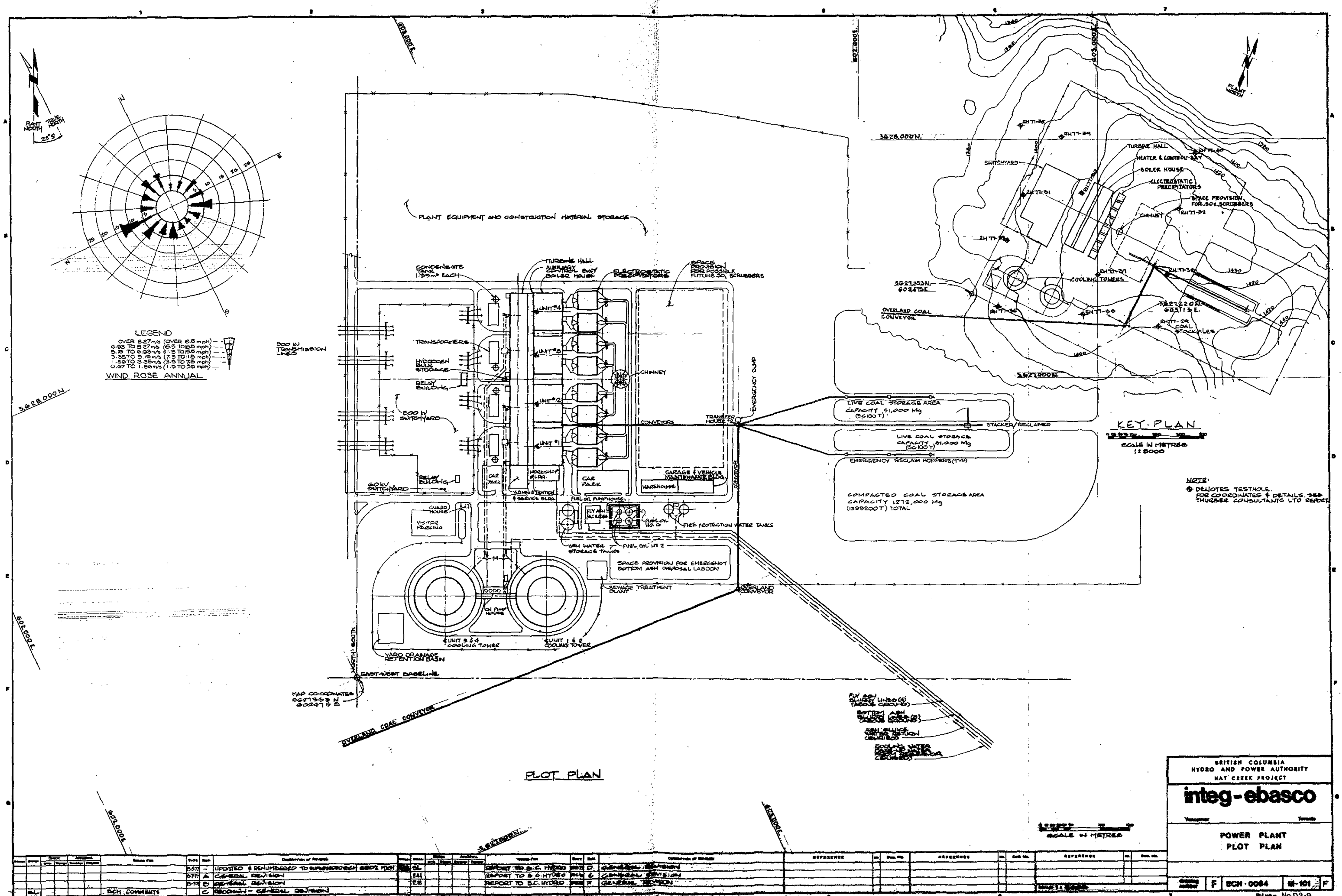
Vancouver Toronto

POWER PLANT
FLOW DIAGRAM
COAL HANDLING SYSTEM

| | | | | | |
|---|---|---|---|---|---|
| G.T. | W.D. | G.J. | BCH. REPORT. | D | REDRAWN |

drawing number F BCH-0064 M-116 D

Plate No. D3-8



PLANT NORTH
TRUE NORTH
25°5'
LEGEND
WIND ROSE ANNUAL
500 kV TRANSMISSION LINES
PLANT EQUIPMENT AND CONSTRUCTION MATERIAL STORAGE
CONDENSATE TANK
TURBINE HALL
AUXILIARY CONTROL BAY
BOILER HOUSE
ELECTROSTATIC PRECIPITATORS
SPACE PROVISION FOR POSSIBLE FUTURE SO2 SCRUBBERS
TRANSFORMERS
HYDROGEN BULK STORAGE
RELAY BUILDING
CHIMNEY
500 kV SWITCHYARD
CONVEYORS
TRANSFER HOUSE
EMERGENCY DUMP
60 kV SWITCHYARD
CAR PARK
WORKSHOP BLDG.
ADMINISTRATION & SERVICE BLDG.
GARAGE & VEHICLE MAINTENANCE BLDG.
WAREHOUSE
FUEL OIL PUMPHOUSE
GUARD HOUSE
VISITOR PARKING
FIRE PROTECTION WATER TANKS
ASH WATER STORAGE TANKS
FUEL OIL No 2
SPACE PROVISION FOR EMERGENCY BOTTOM ASH DISPOSAL LAGOON
SEWAGE TREATMENT PLANT
OVERLAND CONVEYOR
UNIT 3 & 4 COOLING TOWER
UNIT 1 & 2 COOLING TOWER
YARD DRAINAGE RETENTION BASIN
NORTH-SOUTH
EAST-WEST BASELINE
MAP CO-ORDINATES
OVERLAND COAL CONVEYOR
LIVE COAL STORAGE AREA
STACKER/RECLAIMER
EMERGENCY RECLAIM HOPPERS (TYP)
COMPACTED COAL STORAGE AREA
PLOT PLAN
KEY PLAN
SCALE IN METRES 1:5000
SWITCHYARD
TURBINE HALL
HEATER & CONTROL BAY
BOILER HOUSE
ELECTROSTATIC PRECIPITATORS
SPACE PROVISION FOR SO2 SCRUBBERS
CHIMNEY
COOLING TOWERS
OVERLAND COAL CONVEYOR
COAL STOCKPILES
NOTE:
DENOTES TESTHOLE.
FOR COORDINATES & DETAILS, SEE THURBER CONSULTANTS LTD REPORT
SCALE IN METRES
BRITISH COLUMBIA
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
integ-ebasco
POWER PLANT
PLOT PLAN
BCH-0064
M-101
F


Plate No.D3-9

SECTION D4.0 - LIST OF COAL QUALITY AND HANDLING REPORTS AND STUDIES


1. PD-NCB/Wright/Golder. Preliminary Report on Hat Creek Openpit No. 1. Vol. I March 1976.

2. A.J. Sinclair. Evaluation of Analytical Data from Test Holes 76-135 and 76-136 - Hat Creek No. 1 Coal Deposit. March 1977.

3. Birtley. Results of Washability and Plant Washing of Samples from A, B and C - the Hat Creek Deposit. June 1976.

4. Birtley. Analysis and Beneficiation of Bulk Samples "A", "B" and "C" from the Hat Creek Deposit. August 13, 1976.

5. J. Howard Griffiths and G. Armstrong. Hat Creek Project Notes on the Washing Tests at Birtley Engineering (Canada) Ltd., Calgary. June 1976.

6. EMR CANMET ERL Report 77-96(TR). Pilot-Scale Combustion Studies with Hat Creek Coal. October 1977 (and previous Interim Reports).

7. Simon Carves. Hat Creek Beneficiation of Low Grade Coals. March 1978.

8. Simon Carves. Draft Report on the Potential Application of Alternative Processes for the Beneficiation of Hat Creek Coals. December 1977.

9. Simon Carves. Washability Testwork of 1977 Bulk Samples. February 1978.

10. Simon Carves. Hat Creek Coal Beneficiation. June 1978.

11. Simon Carves. Beneficiation of Low Grade Coals. March 1978.

12. B.C. Hydro/CANMET. Pilot-scale Preparation Studies with Hat Creek Coal. Preliminary Report, April 1978.

13. B.C. Hydro. Bulk Sample Report. August 1978.

14. Cominco-Monenco Joint Venture. Hat Creek Project, Mining Feasibility Report, Vol. I to Vol. VI, and Appendices A and B. September 1978.

15. Albert F. Duzy, Martial P. Carriveau et al. Western Coal Deposits Pertinent Qualitative Evaluations Prior to Mining and Utilization. Ninth Lignite Symposium, May 1977.

16. C.D. Suydam, Jr. and A.F. Duzy. An Economic Evaluation of Washed Coal for the Four Corners Generating Station. Combustion, April 1978.

17. Integ-Ebasco. Hat Creek Conceptual Design Report. January 1977.

18. Stone and Webster. Hat Creek Coal Utilization Study. October 1977.

19. Integ-Ebasco. Coal Report. January 1977.

## SECTION D5.0 - GLOSSARY

| | | |
|---|---|---|
| APL | - | Alberta Power Limited |
| Btu/lb | - | British thermal units/pound |
| C | - | celsius |
| CCRL | - | Canadian Combustion Research Laboratories |
| CMJV | - | Cominco - Monenco Joint Venture |
| db | - | dry basis |
| EMR | - | Energy Mines and Resources |
| ft | - | foot |
| hp | - | horse power |
| in | - | inch |
| kg/GJ | - | kilogram/gigajoule |
| kW | - | kilowatt |
| m | - | metre |
| M | - | million |
| MCS | - | meteorological control system |

| | | |
|---|---|---|
| MJ/kg | - | megajoules/kilogram |
| mm | - | millimetre |
| m/s | - | metres/second |
| Mt | - | megatonne |
| MW | - | megawatt |
| ROM | - | run of mine |
| SDM | - | Station Design Manual |
| t | - | tonne |
| t/h | - | tonnes/hour |
| yd | - | yard |