Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada

CANMET
Canada Centre for Mineral and Energy Technology
Centre canadien de la technologie des minéraux et de l'énergie

SECOND SUMMARY REPORT OF THE STATUS OF CANADIAN CLM PROJECTS: IEA COAL-LIQUID MIXTURES IMPLEMENTING AGREEMENT ANNEX II BASE TECHNOLOGY

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OCTOBER 1983

Presented at the 3rd Technical Committee Meeting IEA/CLM Implementing Agreement, Annex II CLM Base Technology "Co-operation in the Exchange of Base Technology Information for Coal Liquid Mixtures", Fukuoka, Japan October 25, 1983

ENERGY RESEARCH PROGRAM
ENERGY RESEARCH LABORATORIES
DIVISION REPORT ERP/ERL 83-66 (OP)

SECOND SUMMARY REPORT OF THE STATUS OF CANADIAN CLM PROJECTS: IEA COAL-LIQUID MIXTURES IMPLEMENTING AGREEMENT ANNEX II BASE TECHNOLOGY OCTOBER 1983

by

Horace Whaley

INTRODUCTION

Objectives of the Canadian CLM Program

The ultimate objective of the Canadian coal-liquid-mixture program is to derive enough data concerning the fuels and how to burn them that potential users will be able to make decisions to replace oil, based on economics and without technical risk. An essential sub-objective is the establishment of a quality-cost-price relationship. Obviously it costs more to prepare a high quality (i.e. low sulphur, low ash) mixture than a low quality one. Research into the application of oil agglomeration to coal-oil-water mixtures has indicated the costs in terms of light oil addition for various levels of rejection of mineral matter including sulphur. Depending on the fineness of grind and mineral content needed, light oil requirements may vary from 1% to 5% of coal weight. For coal-water mixtures, conventional cleaning applied to the highest quality coal can reduce mineral matter to 3% and sulphur to 1.2%: grinding and multistage flotation can reduce these levels to 1.5% and 0.8% respectively: if lower quality (less expensive) coals are used, the same process is expected to attain about 3% minerals and 1.5% sulphur, the cost difference being in the starting feedstock coal rather than in the process.

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Use of coal-liquid mixtures by utilities requires a delivery and storage system, including stirring vessels where necessary, and pumps which can deal with fluctuations in diurnal and seasonal demand. The program is demonstrating methods of transportation which will be applicable to industrial users and, later this year, some of the combustion tests will be scheduled in freezing weather so that any problems due to low temperature operations can be detected and solved. Addition of anti-freeze such as methanol may be necessary, this will add to the cost but may improve combustion characteristics.

The performance of utility boilers designed for oil will be significantly different when using coal-water mixtures. The problem of unit derating has already been mentioned and each unit to be converted will need a detailed individual assessment to ascertain its loss in electrical generating capacity when firing a typical coal-water mixture. Again, the derating will depend strongly on the fuel and the boiler design. One of the objectives of the current program is to provide data for the determination of the inter-relationship between properties and quantity of mineral matter in the coal-water fuel, the flame and unit derating. The utility company will then determine the net loss in its system generating capacity if several units are to be converted to coal-water fuel. It must by noted that a significant requirement of the coal-water mixture program is that the slurry burners be compatible with the retention of fuel oil capability to attain full generating capacity during peak demand periods.

Assuming successful demonstrations at Chatham, the next steps proposed are to conduct tests in oil-designed boilers of similar size to the larger Chatham boiler and then to design systems for burning coal-water fuel in larger utility units. In eastern Canada there are several larger front-wall and tangentially-fired oil-designed units. The current program embraces the design of coal-water systems for both configurations.

DEUXIEME RAPPORT SOMMAIRE SUR LA SITUATION DES PROJETS MCL (MELANGES CHARBON-LIQUIDE): ENTENTE AVEC L'AIE SUR LES MELANGES CHARBON-LIQUIDE ANNEXE II - TECHNOLOGIE DE BASE OCTOBER 1983

par

Horace Whaley*

INTRODUCTION

Objectifs du programme canadien sur les MCL

L'objectif ultime du programme canadien sur les MCL consiste à recueillir suffisamment de données au sujet des combustibles et des techniques utilisées pour les brûler afin que les utilisateurs éventuels soient en mesure de prendre des décisions en ce qui concerne les substituts du pétrole fondées sur des études économiques et éliminant les risques techniques. Un des objectifs de deuxième ordre mais tout autant essentiel vise à établir une relation qualité - prix coûtant. Évidemment, il est plus coûteux de préparer un mélange de haute qualité (c'est-à-dire faible en soufre et en cendre) qu'un mélange de basse qualité. Les résultats de recherches effectuées sur l'agglomération de pétrole aux mélanges charbon-pétrole-eau ont indiquée les coûts en fonction de l'addition d'huile légère pour divers niveaux de rejet de substances minérales, incluant le soufre. Les exigences en ce qui concerne la quantité de charbon légère peuvent varier de 1% à 5% du poids de charbon, selon la finesse du grain et le contenu en minéraux nécessaires. Les méthodes de lavage classiques appliquées à la plus haute qualité de charbon peut réduire la présence de substances minérales à 3% et celle du soufre à 1,2% dans les mélanges charbon-eau. Le broyage et la flottation à étape multiple peuvent réduire ces niveaux à 1,5% et 0,8% respectivement. Si on utilise des charbons de moindre qualité (moins coûteux par conséquent), on obtiendra par ces mêmes procédés des niveaux atteignant 3% de minéraux et 1,5% de soufre. Dans ce cas-ci, la différence de coût dépend de la matière première (le charbon) plutôt que du procédé appliqué.

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L'utilisation de mélanges charbon-liquide par des utilisateurs privés demande que l'on implante des systèmes de livraison et d'entreposage, qui comportent des récipients d'agitation si nécessaires et des pompes qui peuvent s'adapter aux fluctuations journalières et saisonnières selon la demande. Le programme fait la démonstration de méthodes de transport applicables à l'industrie privée. Plus tard au courant de l'année, on effectuera des essais de combustion par temps glacial de façon à détecter et à solutionner les problèmes rencontrés dans de telles conditions climatiques. L'addition d'antigel, tel que le méthanol, peut être nécessaire et peut améliorer les propriétés de combustion même si le coût en est ainsi augmenté.

Le rendement des chaudières conçues pour le pétrole sera très différent lorsqu'on utilisera des mélanges charbon-eau. On a déjà fait mention du problème de la dévaluation des unités et il est nécessaire que chaque unité convertie soit évaluée en détail et individuellement en fonction de la perte en puissance de production d'électricité lors de la combustion d'un mélange charbon-eau classique. Encore une fois, la dévaluation dépendera grandement du combustible et de la conception de la chaudière. Un des objectifs du présent programme consiste à fournir des données pour déterminer la relation entre les propriétés du minerai et sa quantité dans le combustible charbon-eau, la flamme et la dévaluation de l'unité. La compagnie déterminera par la suite la perte nette dans son système du puissance de production si plusieurs unités sont converties aux combustibles charbon-eau. Il est important de prendre note qu'une des exigences du programme sur les mélanges charbon-eau est que les brûleurs de bouillie puisse conserver le pétrole afin d'atteindre la puissance maximale de production aux périodes de consommation de pointe.

En supposant que la démonstration à Chatham soit couronnée de succés, les étapes suivantes proposées consistent à mettre à l'essai les chaudières conçues spécialement pour le pétrole, de format semblable à celui de la grosse chaudière de Chatham et finalement, à concevoir des systèmes capables de brûler des combustibles charbon-eau dans des unités plus grosses. Dans l'est du Canada, il existe plusieurs unités conçues pour utiliser du pétrole dont les brûleurs sont montés sur un seul des murs ou sur les quatre murs de la chaudière. Le présent programme comprend la conception de systèmes pour les combustibles charbon-eau selon des deux modèles d'unités.

Le programme comprend aussi plusieurs projets qui s'entrecroisent pour atteindre les objectifs mentionnés auparavant. Un de ces projets consiste à construire une usine pilote de 7 tonnes par heure à Sydney en

Nouvelle-Écosse, pour la préparation d'un mélange charbon-eau contenant plus de 70% de charbon, et à concevoir des brûleurs qui conviennent à la combustion efficace de ce combustible. La démonstration de l'utilisation des mélanges charbon-eau et l'apport technologique de soutien nécessaire à ces deux projets constituent la base du programme de travail sur les contributions canadiennes à l'AIÉ - Annexe II. La conception de mélanges charbon-eau et de systèmes de brûleur pour des unités plus grosses constitue un volet complémentaire à ces projets.

Project No. 1: CWM Preparation Plant

The CWM prepartion pilot-plant using the AB Carbogel (Sweden) process treats clean coal (-3 mm) from an adjacent conventional dense medium coal preparation plant which reduces the mineral matter content from about 8% to 3%. The pilot plant illustrated in Fig. 1 comprises two stages of grinding, particle size control, two stages of froth flotation (further reducing the mineral matter to about 1.5%) and the mixer to add a stabilizer. The process is based on the proprietary CARBOGEL process. The target solids content is about 75% with viscosity in the 800-1500 centipoise range (at 30 shear rate). Use of higher quality coal is planned for the first trials to minimize problems with ash handling but different coals with higher mineral and sulphur contents and with poorer washability characteristics could save $20 per tonne (of coal). The prepared fuel is held in day-storage tanks for regular delivery by rail (one tank car per day for about 750 km) to Chatham: storage tanks of 500 m^3 capacity which were already in existence at Chatham form the buffer to match demand with production capacity. Fuel production costs are recovered by the producer through the price charged to the electric utility. The utility then passes on the differential between this price and normal coal-fired generating costs, as well as the cost of burner development, to the federal government. Construction of the pilot plant began in November 1982 and was completed by early July 1983 with regular fuel production beginning mid July by 1983. (See the Project Manager's Reports attached). On July 16, 40 tonnes of CWM were shipped to Chatham for transportation, handling and storage tests. Since that time about 800 tonnes of fuel have been shipped to Chatham and burned in the tests on unit No. 1 (see report on project 2). There have been some problems encountered in the secondary grinding circuit and particle size distribution control but these had been resolved at the time of writing.

Project No. 2: Development of CWM Burners for Front-Wall and Tangentially Fired Boilers at Chatham, New Brunswick

Development of CWM burners for the units at Chatham is being undertaken concurrently with the construction of the coal-water pilot-plant preparation facility. The two phases of burner development are as follows:

The design, testing and evaluation of burners, rated at approximately 30 GJ/h thermal input, suitable for coal-water slurry fuel combustion in the 10 MW(e) front-wall fired unit. An evaluation program for burner and boiler performance assessment was developed for the performance trials which are to be undertaken in this unit during the second phase. A parallel program to develop 60 GJ/h burners for the tangentially fired configuration is leading to performance trials in the 22 MW(e) unit.

Key elements of the first phase were a review of the state of the art of coal-liquid mixture burner technology and recommendation of the most promising burner concepts for coal-water mixture firing for each boiler configuration. Full-scale burners have been designed and were tested prior to installation in the units at Chatham.

The present progress on the burner development aspects of the program are as follows:

Foster Wheeler Canada subcontracted the development of burners for Unit 1 to their subsidiary Forney Engineering of Dallas. A quantity of design fuel was shipped to Forney and a test burn of the fuel was conducted in December 1982. After this test work, manufacture of the four burners commenced and these are now installed at Chatham, tests on the unit have been completed, except for the performance tests.

Modifications to the No. 2 boiler have been finalized and installed. This includes a minor modification to the burner front duct work, the complete removal of the existing burners along with some refractory quarl, replacement of pressure tubes and installation of the four new burners. C.E. Canada subcontracted the atomizer testing to K.D.L., their research facility in Windsor CT. The atomizers requirements were that it use low pressure air or steam for atomization and also provide adequate atomization quality. This has been achieved in the test facility and tests on Unit No. 2 are scheduled to begin in mid October.

Project No. 3: Coal-Water Mixture Derating Assessment of Oil-Designed Utility Boiler

The specific objectives of this project were to assess the probable derating of oil-designed utility boilers of 60 and 200 MW(e) and of four typical Canadian designs when firing CWM's at varying boiler loads. The CWM's to be studied were designated commercial fuel, and are higher in ash (3% and 9%) than the design fuel used for Project Nos. 1 and 2. It is expected that this range of ash level variation will give some information on the costs of coal cleaning versus flue gas clean-up as well as on the derating aspects of the project.

The present status of this project is that the report on the front-wall fired units is available from CANMET and a paper has been written on the findings (see attached report in ERP-ERL 83-64(OP). The report on the tangentially fired units has just been received by the author and has yet to be evaluated in detail.

Project No. 4: Fluidized-Bed Combustion of Coal-Water Mixtures

Coal cleaning operations produce large quantities of combustible tailings containing a large fraction of ash and moisture. These tailings pose a difficult disposal problem. It is the intention of Energy, Mines and Resources Canada to explore the feasibility of incinerating such slurries in a fluidized-bed combustor as an alternate means of disposal. Concurrently, EMR wishes to explore fluidized-bed combustion techniques as an alternative to conventional combustion for higher quality CWM. This avoids the problems of atomizer wear and to some extent the need for low ash and sulphur fuels.

Babcock and Wilcox Canada Ltd is the designated contractor and will carry out parameteric fluidized-bed combustion studies with a 0.3 m x 0.3 m pilot FBC at B & W's Alliance Research Center. Three water slurry fuels, including thickener underflow from a western Canadian coal preparation plant; beneficiated eastern Canadian coal prepared by the Carbogel process (design fuel) and an unbeneficiated eatern Canadian coal prepared by the NRC and Scotia Liquicoal in Halifax, N.S., have been tested and stable, efficient combustion has been achieved in a fluidized-bed combustor in the case of the latter two fuels. The test program has consisted of optimum input conditions determination; measurement of combustion efficiency, measurement of pollutant emissions and, with the high-sulphur feedstocks determination of the efficiency of sulphur capture with limestone.

There have been some problems with the thickener underflow material (70% water). These were feed-line plugging, defluidization of the bed and cooling circuit leaks. It is expected that the work will now last into 1984 with the final report in March 1984.

Project No. 5: Spherical Agglomeration applied to CLM's

Objectives: Recovery and beneficiation of waste fine coals by oil agglomeration followed by utilization in CLM's. Use of spherical agglomeration to produce cleaner CLM's by rejection of impurities liberated during size reduction for CLM preparation.

Organization: Chemical Engineering Section, Division of Chemistry, National Research Council, Ottawa, Canada K1A 0R9

Project Manager: C. E. Capes, at above address.
K. F. Burrill, Scotia Liquicoal Ltd
Halifax, Nova Scotia

Recent Progress (October 1983)

Demonstrated recovery of waste fine coal in thickener underflow from Victoria Junction Wash Plant of Cape Breton Development Corporation. (C.B.D.C.) Mobile pilot plant operated during July - Sept. recovering agglomerated product at rates up to about 4 tph. (Note: this is the same plant which provides feedstock for C.B.D.C.'s CWM plant, see project No. 1).

Laboratory work continued on the formulation, rheology and other relevant characteristics of coal-water fuels made from agglomerates, both of waste coal and of run-of-mine coals benificiated by oil agglomeration.

Demonstration quantities of coal water fuels were manufactured for combustion testing, using the preparation facilities of Scotia Liquicoal Limited. Recovered Waste fines and unbeneficiated Cape Breton coal, both of 10-15% ash level, and low-ash metallurgical coals were used in this work. Combustion tests were conducted in the flame tunnel of TUNS in Halifax and as part of the CWM combustion tests at the B & W Alliance Research Center. (see project No. 4)

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Project No. 6: Development of CLM Burner Tip and Assembly

Objective: Development of an erosion-resistant burner tip and compatible burner assembly for CLM combustion.

Organization: Atlantic Research Laboratory, Halifax, Nova Scotia and Division of Chemistry, National Research Council, Ottawa, Canada K1A 0R9

Project Manager: D.W. Burnett (CLM Technology Ltd., Halifax)
Also S.G. Whiteway and W. Thayer (NRC)

Recent Progress (October, 1983)

1 Atomizer of annular design was adapted for CW fuels in a light of experience in test burns. Modifications included adjustable air and fuel channels to allow experimentation with different fuels, simplifies and more robust design, especially of the ceramic wear parts and improved alignment procedures.
2. Several Test burns of up to 10 hours duration were performed in the TUNS CES flame tunnel in Halifax aimed at the burner tip and assembly development and at various CWM faormualtions.
3. Longer term combustion testing for the burner assembly, which has shown excellent resistance to erosive fuels, are planned.

4. A list of reports, available from the Canada Institute for Scientific and Technical Information (CISTI) of the National Research Council in Ottawa, follows:

A. Kazi and S.G. Whiteway "Erosion Resistant Ceramics for Coal Utilization"
ARL Technical Report 31 (1982)

A. Al Taweel "Erosion of Materials using Recirculated Coal-Liquid Mixtures"
ARL Technical Report 32 (1982)

Scotia Liquicoal Ltd.
"Abrasion of Ceramic - Modified Flo - Sonic Nozzle, Using a Hot-Spray Test Loop"
ARL Technical Report 33 (1982)

Scotia Liquicoal Ltd.
"Abrasion of Peabody Nozzle, Using a Hot-Spray Test Loop"
ARL Technical Report 34 (1982)

Scotia Liquicoal Ltd.
"Ten-Hour Burn of COW Using Ceramic - Modified Flo-Sonic Nozzle".
ARL Technical Report 35 (1982)

Project No. 7: Coal-Liquid Mixture Combustion Parameters

The specific objectives of this program are to determine basic combustion parameters for commercial CLM's as they become available in Canada. The specific test program will be as follows:

1. To determine the aerodynamic requirements for a stable CLM flame;
2. To evaluate the flame and heat transfer characteristics of the CLM's under controlled aerodynamic and combustion conditions;
3. To assess the gaseous and particulate emissions produced during the tests; and

4. To compare the performance of the CLM with No. 6 fuel oil and coal.

The program is being carried out in the CCRL pilot-scale tunnel furnace, maximum thermal input 3 GJ/h and compromised of 28 individual calorimetric sections. Residence time and flame stability can be varied by the addition of an adiabatic pre-ignition section, if necessary. One burner to be used will be that developed by NRC (Project No. 6) together with an available commercial burner and one developed by CCRL. The first fuel to be studied was a typical Scotia Liquicoal product (COW). Carbogel CWM (design fuel) from the coal/water utility development program in the maritimes is currently being evaluated (See Project No.s 1 and 2). Each of these fuels is made from the same feedstock coal and this will be burned as pulverized coal for reference.

H. Whaley
83 10 17

SUMMARY OF STATUS

COAL WATER BURNER DEVELOPMENT PROJECT

AUGUST 23, 1983

D. M. RANKIN, P.ENG.

PROJECT MANAGER

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

FREDERICTON, NEW BRUNSWICK   CANADA

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In April 1982, Energy, Mines and Resources Canada (EMR) and The New Brunswick Electric Power Commission (NB Power) and The Cape Breton Development Corporation (CBDC) entered into an agreement to demonstrate the preparation of coal water slurry and to develop burners for use in utility boilers.

In addition, the Cape Breton Development Corporation signed a licensing agreement with AB Carbogel of Sweden to manufacture and market coal water slurry based on the preparatory carbogel technology with exclusive rights in Eastern Canada. Under the agreement, a pilot plant for the production of coal water slurry was built at Sydney, Nova Scotia. Burners are being developed and tested in the front fired boiler and the tangintally fired boilers at Chatham, New Brunswick.

This project is funded by Canada Department of Energy, Mines & Resources. The project is managed by NB Power under the direction of a Steering Committee made up of representatives form EMR Canada, NB Power, Cape Breton Development Corporation, The Nova Scotia Power Corporation and AB Carbogel.

A Technical Committee made up of representatives of the Steering Committee plus the National Research Council of Canada, Ontario Hydro, The New Brunswick Research and Productivity Council and the Centre for Energy Studies of the Technical University of Nova Scotia and EPRI is to provide technical advice to the project.

The pilot plant has been constructed at Sydney, NS. This plant is now in operation with a production rate of about 4 tonnes per hour. This is gradually being increased to about 7 tonnes per hour.

The feed stock to the pilot plant is Cape Breton Harbour Seam Coal which has an ash content of approximately 15% and a sulphur content of 1.8%. This coal is passed through a wash plant which reduces the ash content of approximately 2.8% and the sulphur to 1.2%. After passing through the process for producing the coal water slurry, the ash is approximately 1.7% and the sulphur is 0.9%.

It should be noted that in general the feed stock to the pilot plant is rather good quality coal. The reason for this was to try to minimize some of the variables for the development of the burners.

There are two stages of grinding. The material passes through the first ball mill and through a sieve bend. The product which is rejected passes through the second ball mill and through a cyclone. The fines passed over the sieve bend and the rejects back through the second ball mill. The product then passes through two sets of floatation cells, a surge tank and a filter unit to remove moisture.

In the mixers the chemicals are added, then the slurry passes through temporary storage in order that the product can be checked prior to admission to the final storage.

The fuel is transported from Sidney, NS to Chatham, New Brunswick by rail tank cars.

The work on the second major part of the project, the burner development, involved the placing of two contracts, one with Foster Wheeler Canada for the development of burners for front fired boilers. The second with C.E. Canada for the development of burners for tangintal fired units.

Other work included providing suitable storage and handling facilities for the fuel at the station and making the necessary boiler modifications to accommodate the new burners.

STEAM GEN. #1 FRONT FIRED UNIT

MANUFACTURER FOSTER WHEELER

STEAM FLOW 140 000 POUNDS PER HOUR

OPERATING PRESSURE IS 605 PSIG

STEAM TEMPERATURE 835°F

NO REHEAT

FEEDWATER TEMPERATURE ENTERING THE BOILER IS 350°F

A balanced draft front fired unit with 4 burners.

This boiler was originally designed to burn coal but has since been conferted to burn Bunker C fuel oil.

STEAM GEN. #2 CORNER FIRED UNIT

SUPERHEATER LTD.

STEAM FLOW OF 210 000 POUNDS PER HOUR.

AN OPERATING PRESSURE OF 860 PSIG.

A STEAM TEMPERATURE OF 900°F

NO REHEAT

Feedwater temperature of 354°F a balanced draft tangental fired unit with four burners.

This boiler was originally designed to burn coal and has been converted to burn #6 fuel oil.

Quantities of the design fuel were manufactured in Sweden by AB Carbogel. This fuel was supplied in the quantities requested to each of the burner designers so that they could proceed with test work and the design of the burners in parallel with the engineering and construction of the pilot plant.

The Foster Wheeler Canada subcontracted portion of their work to Forney Engineering in Dallas. A quantity of fuel was shipped to Forney and a test burn of this fuel was conducted in early December of 1982 at the Forney Test Facility.

UNIT #1 FRONT FIRED STATUS

The boiler modifications have been completed and the new burners installed. The oil base line tests have been completed .

The first CWM fuel was burned on July 29, 1983. Several hundred tons of CWM have been burned since then. As this is the first production from the start up of the pilot plant the fuel was not to specification, but did burn fairly well. Problems at the pilot plant are gradually being resolved and the CWM produced is becoming more uniform with a viscosity of less than 1500 centipoise.

TEST PROGRAM

It is planned to demonstrate the combustion of at least 3 000 tonnes of the fuel in each unit at Chatham in order to achieve the following broad program objectives:

1. Determine the combustion characteristics of the fuel in utility boilers.
2. Evaluate the performance of coal water slurry burner equipment as to reliability and efficiency.
3. Make measurements over a range of operating conditions in order to evaluate boiler performance and environmental implications of the fuel and burners.
4. Determine the technical feasibility of performing an on load switch between oil and coal water slurry.
5. Assess the performance of fuel handling equipment and instrumentation for coal water slurry.

Following is a one-line diagram which schematically summarizes the planned test program. It should be noted that this concept of testing will be used for both units at the station.

Day	1	5	15	20 -	50	53	55
Fuel	Oil	CWF	CWF	CWF	CWF/Oil/CWF	CWF	Oil
Object	Initial Baseline	Nozzle Selection	Initial Baseline	Burner Life Test	Fuel Switch	Baseline Check	Baseline Check
Test #	1	2	3	4	5	6	7

It should be noted that the timing indicated is preliminary and will be modified as the program proceeds. A brief description of each element follows:

1. the initial operation of the modified units is on residual oil. The objectives are to provide operator training and to establish the baseline performance and environmental data.
2. Several nozzle materials are available for the #1 unit. This test is planned to involve the installation of up to 8 different materials (4 at a time) for an initial 100 hour evaluation period. After this time the nozzles will be examined and those showing the best combustion and wear characteristics will be selected.
3. After completion of the nozzle selection process a baseline test on coal water fuel will be performed. This test will yield data which is comparable to that obtained from test 1. The results of this

test will in large measure, determine the importance of any capacity reduction which might be experienced when burning coal water fuel.

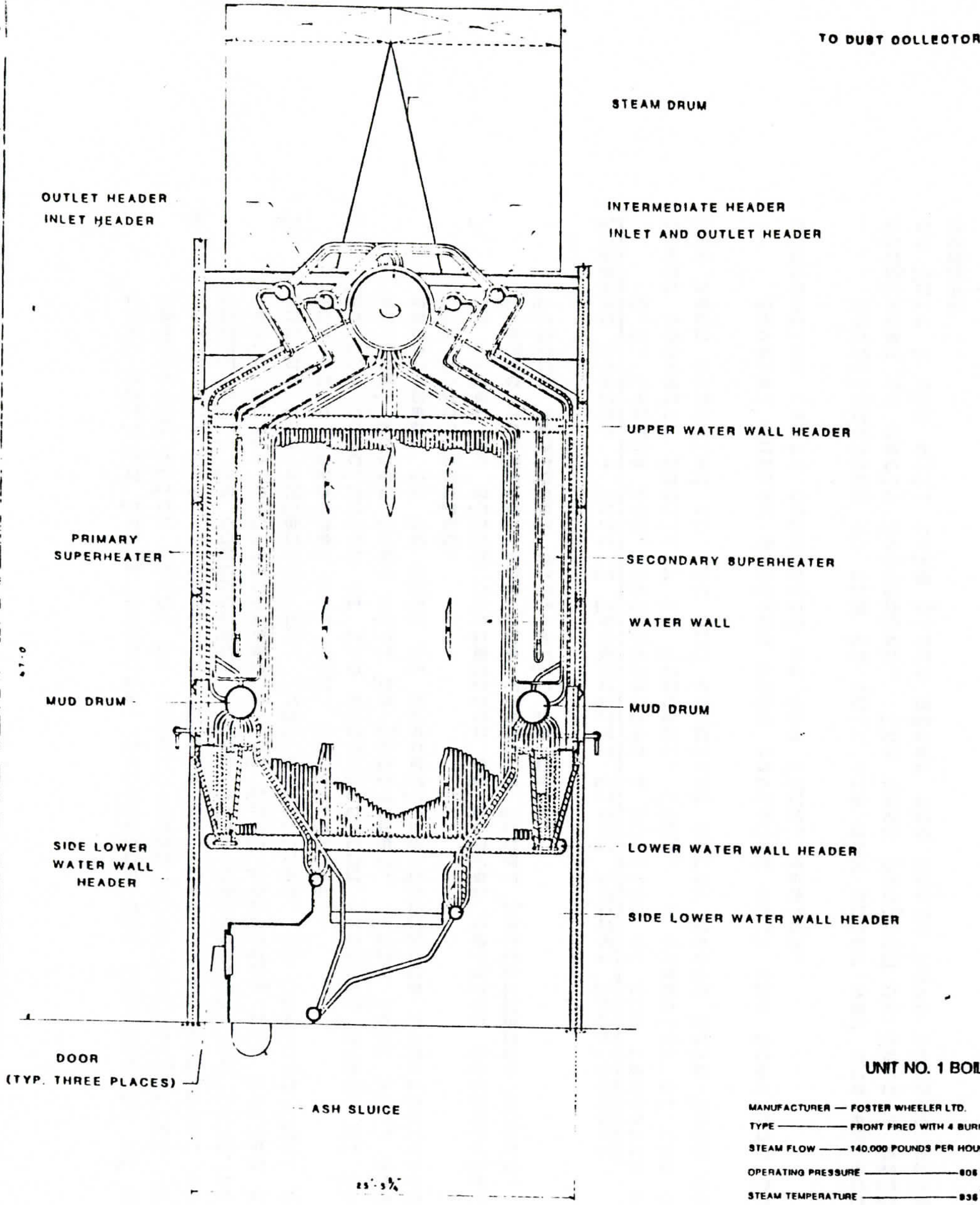
4. Using the most promising nozzle materials, an extended combustion trial will be conducted. This will establish the long term performance characteristics of fuel handling and boiler components.
5. During the extended run just described, an on-load fuel switch to and from residual oil will be attempted.
6. At the conclusion of the extended run a final check of the baseline on coal water fuel will be performed. This test will allow an assessment to be made of overall performance deterioration during the trial period.
7. In order to allow correction of boiler related deterioration due to fouled surfaces and the like, a final performance check, while firing residual oil, will be made.

Present Status - Unit 2 Tangential Fired Burner Development

C.E. Canada has subcontracted a portion of the research work to KDL, their research facility in Windsor, Conn. A quantity of the design fuel has been supplied to KDL and atomizer spray tests have been conducted.

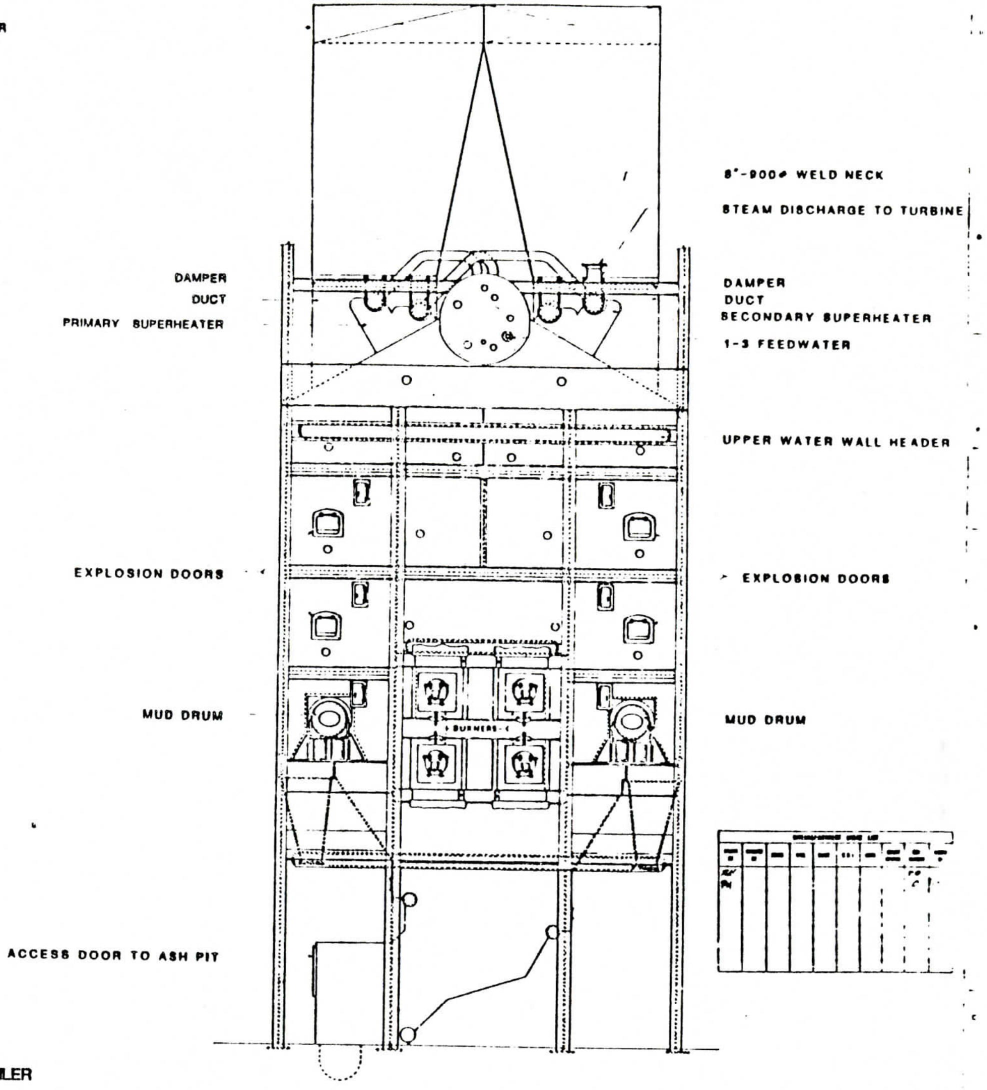
Several burner designs were reviewed with the Steering Committee and combustion tests conducted on the final design.

Modifications to the #2 unit are now under way and expected to be completed in early September. The test program on Unit 2 will be similar to Unit 1 and will take place after the tests have been completed on Unit number 1.



SECTION "A-A"

WITH FRONT OF BOILER REMOVED



FRONT ELEVATION WITH DUCTING REMOVED

UNIT NO. 1 BOILER

MANUFACTURER — FOSTER WHEELER LTD. ST. CATHARINES ONTARIO
TYPE ———— FRONT FIRED WITH 4 BURNERS
STEAM FLOW ——— 140,000 POUNDS PER HOUR
OPERATING PRESSURE ———— 605 P.S.I.G.
STEAM TEMPERATURE ———— 835° F
REHEAT ———— NONE
FEEDWATER TEMPERATURE ———— 350° F (ENTERING THE BOILER)

THE BOILER WAS ORIGINALLY DESIGNED TO BURN COAL BUT HAS SINCE BEEN CONVERTED TO BURN BUNKER C FUEL OIL.

TURBINE OUTPUT ———— 12.5 MW

THIS DOCUMENT IS
FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION

NOTES

No	Reference Drawing	Drawing Number
2	COAL/WATER MIXTURE BURNER DEVELOPMET BOILER DUCTING - ISOMETRIC VIEW	17750-G
1	COAL/WATER MIXTURE BURNER DEVELOPMENT MEASURING POINTS ON BOILER & DUCTING ISOMETRIC VIEW	17863-G

No	Date	Revisions	Loc	By	App

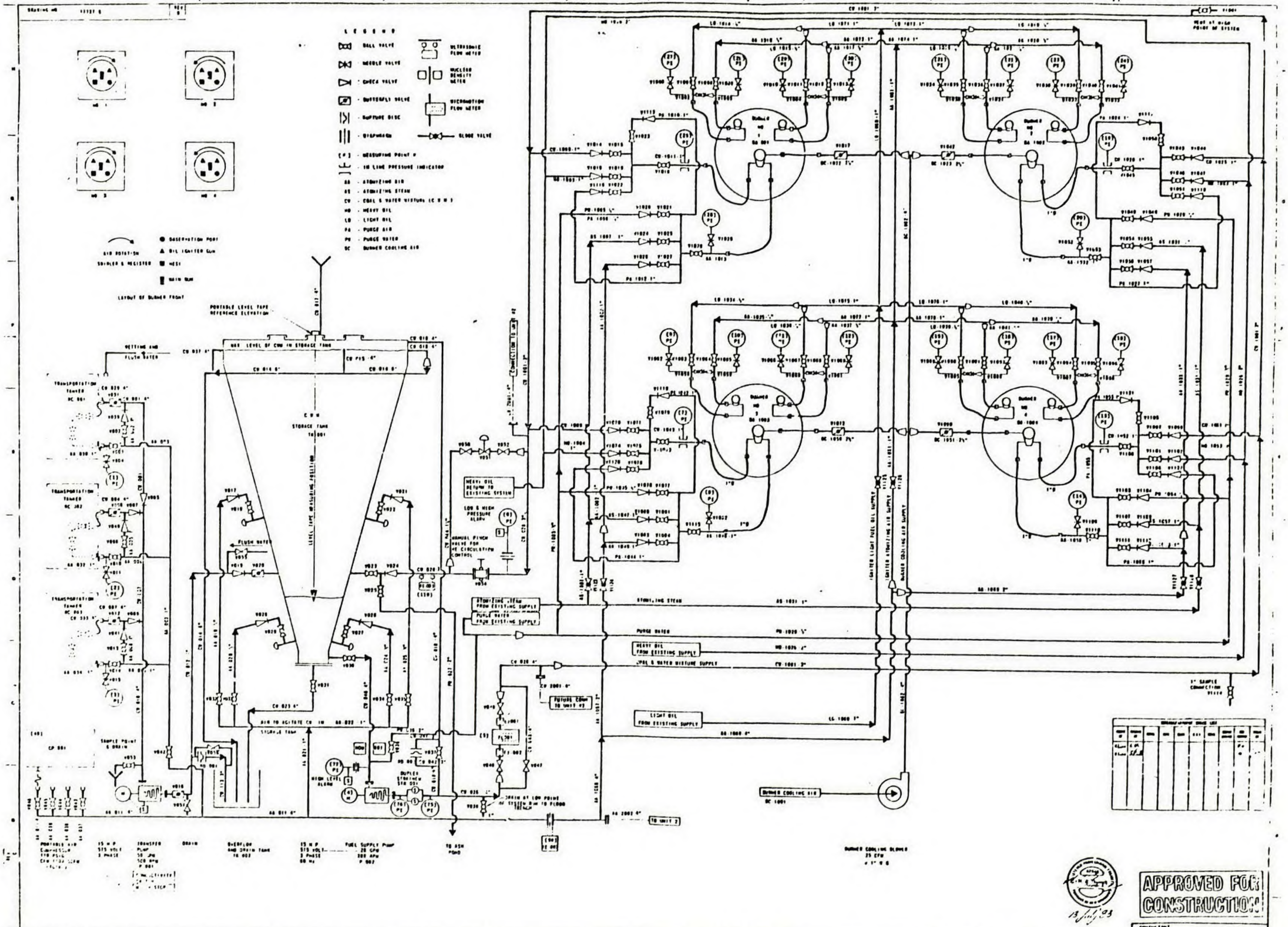
DRAWN [illegible] DATE [illegible]
CHECKED
CHIEF DRAFTSMAN
DESIGNED
Project Engineer Project Manager Mgr. Eng & Constr.
SCALE

CONSULTANT

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION
Fredericton N.B.

PROJECT [illegible]
TITLE COAL/WATER MIXTURE BURNER DEVELOPMENT
BOILER #1
FRONT ELEVATION ARRANGEMENT

DWG NO 17067-G
REV 0



NOTES

APPROVED FOR CONSTRUCTION

13 July '93

CONSULTANT

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

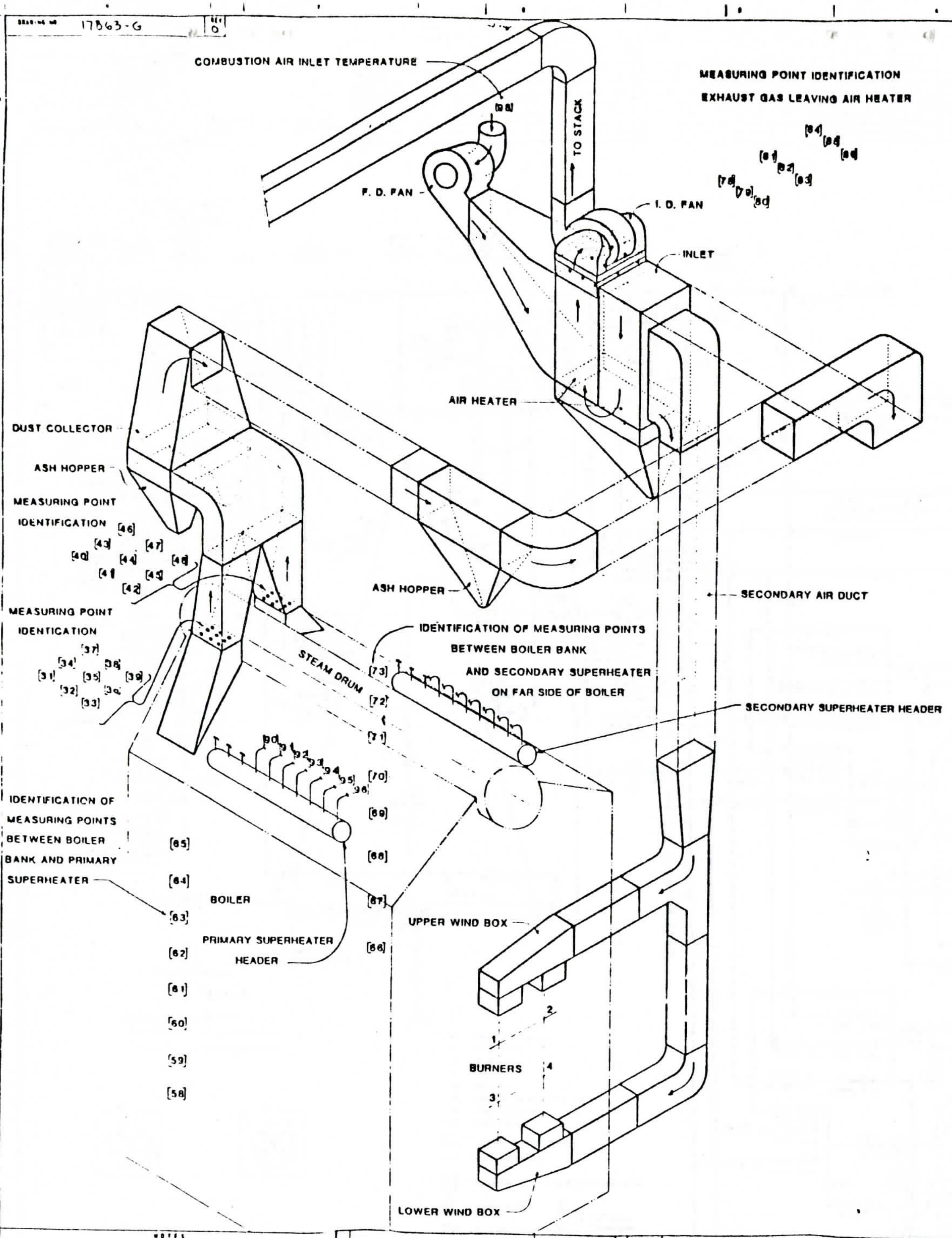
Fredericton N B

PROJECT

TITLE COAL WATER MIXTURE BURNER DEVELOPMENT

17863-G

REV 0



MEASURING POINT	UNITS	DESCRIPTION	UNIT NO
1	PSIG	AIR PRESSURE TO RAIL CAR UNLOADING STATION	1
2	PSIG	AIR PRESSURE TO RAIL CAR UNLOADING STATION	2
3	PSIG	AIR PRESSURE TO RAIL CAR UNLOADING STATION	3
4	KWH	POWER CONSUMED BY PUMPING FUEL TO BURNERS	1
5	USG/HR	CWF RECIRCULATION MASS FLOWMETER	COMMON
6	PSIG	FUEL PRESSURE AT THE BURNER SUPPLY HEADER	1
7	PSIG	FUEL PRESSURE (CWF OR HEAVY OIL) AT BURNER 1	1
8	PSIG	ATOMIZING (STEAM OR AIR) AT BURNER 1	1
9	PSIG	LIGHT OIL PRESSURE AT BURNER 1 IGNITER LEFT	1
10	PSIG	ATOMIZING AIR PRESSURE AT BURNER 1 IGNITER LEFT	1
11	PSIG	LIGHT OIL PRESSURE AT BURNER 1 IGNITER RIGHT	1
12	PSIG	ATOMIZING AIR PRESSURE AT BURNER 1 IGNITER RIGHT	1
13	PSIG	FUEL PRESSURE (CWF OR HEAVY OIL) AT BURNER 2	1
14	PSIG	ATOMIZING (STEAM OR AIR) AT BURNER 2	1
15	PSIG	LIGHT OIL PRESSURE AT BURNER 2 IGNITER LEFT	1
16	PSIG	ATOMIZING AIR PRESSURE AT BURNER 2 IGNITER LEFT	1
17	PSIG	LIGHT OIL PRESSURE AT BURNER 2 IGNITER RIGHT	1
18	PSIG	ATOMIZING AIR PRESSURE AT BURNER 2 IGNITER RIGHT	1
19	PSIG	FUEL PRESSURE (CWF OR HEAVY OIL) AT BURNER 3	1
20	PSIG	ATOMIZING (STEAM OR AIR) AT BURNER 3	1
21	PSIG	LIGHT OIL PRESSURE AT BURNER 3 IGNITER LEFT	1
22	PSIG	ATOMIZING AIR PRESSURE AT BURNER 3 IGNITER LEFT	1
23	PSIG	LIGHT OIL PRESSURE AT BURNER 3 IGNITER RIGHT	1
24	PSIG	ATOMIZING AIR PRESSURE AT BURNER 3 IGNITER RIGHT	1
25	PSIG	FUEL PRESSURE (CWF OR HEAVY OIL) AT BURNER 4	1
26	PSIG	ATOMIZING (STEAM OR AIR) AT BURNER 4	1
27	PSIG	LIGHT OIL PRESSURE AT BURNER 4 IGNITER LEFT	1
28	PSIG	ATOMIZING AIR PRESSURE AT BURNER 4 IGNITER LEFT	1
29	PSIG	LIGHT OIL PRESSURE AT BURNER 4 IGNITER RIGHT	1
30	PSIG	ATOMIZING AIR PRESSURE AT BURNER 4 IGNITER RIGHT	1
31	°F/% O_2	GAS LEAVING BOILER ON PRIMARY S.H. SIDE	
32			
33			
34			
35			
36			
37			
38			
39			
40		GAS LEAVING BOILER ON SECONDARY S.H. SIDE	
41			
42			
43			
44			
45			
46			
47			
48			
49	KWH	POWER CONSUMED BY PORTABLE AIR COMPRESSORS	COMMON
50		BOILER BOTTOM ASH	
51	PSIG	STEAM DRUM PRESSURE	
52	°F	MAIN STEAM TEMPERATURE LEAVING BOILER	
53	PSIG	MAIN STEAM PRESSURE LEAVING BOILER	
54	LB/HR	MAIN STEAM FLOW LEAVING BOILER	
55	PSIG	FEEDWATER PRESSURE	
56	LB/HR	FEEDWATER FLOW	
57	°F	FEEDWATER TEMPERATURE	
58	°F/% O_2	GAS PATH BETWEEN BOILER BANK AND PRIMARY S.H.	
59			
60			
61			
62			
63			
64			
65			
66		GAS PATH BETWEEN BOILER BANK AND SECONDARY S.H.	
67			
68			
69			
70			
71			
72			
73			
74	FEET	LEVEL OF FUEL (CWF) IN BUNKER STORAGE	COMMON
75	PSIG	CWF PRESSURE LEAVING DUPLEX FILTER	COMMON
76	PSIG	CWF PRESSURE ENTERING DUPLEX FILTER	COMMON
77	PSIG	CWF FUEL STORAGE LEVEL (PRESSURE) & ALARM HIGH LEVEL	COMMON
78	°F/% O_2	GAS LEAVING AIR HEATER	
79			
80			
81			
82			
83			
84			
85			
86			
87		NOT USED	
88		NOT USED	
89		NOT USED	
90	°F	ON TRANSFER PIPE FROM PRIMARY TO SECONDARY S.H.	1
91			
92			
93			
94			
95			
96			
97	LB/HR	COMBUSTION AIR FLOW	
98	°F	COMBUSTION AIR TEMPERATURE	
99		STACK - NOX	COMMON
100		STACK - SOX	COMMON
101		STACK - PARTICULATE	COMMON
102		STACK - OPACITY	COMMON
103		STACK - CO	COMMON
104	LB/HR	FIRING RATE OF HEAVY OIL FUEL	1
105	°F	TEMPERATURE OF HEAVY OIL FUEL	1
106		STACK - CO_2	COMMON
107		STACK - O_2	COMMON
108	BTU/FT²/HR	HEAT FLUX MEASUREMENT AT BACK OF BOILER TOP RIGHT PORT	1
109	BTU/FT²/HR	HEAT FLUX MEASUREMENT AT BACK OF BOILER MIDDLE RIGHT PORT	1
110	BTU/FT²/HR	HEAT FLUX MEASUREMENT AT BACK OF BOILER: LOWER RIGHT PORT	1
111	BTU/FT²/HR	HEAT FLUX MEASUREMENT AT BACK OF BOILER: TOP LEFT PORT	1
112	BTU/FT²/HR	HEAT FLUX MEASUREMENT AT BACK OF BOILER: MIDDLE LEFT PORT	1
113	BTU/FT²/HR	HEAT FLUX MEASUREMENT AT BACK OF BOILER: LOWER LEFT PORT	1
114	MWH	UNIT 1 STATION SERVICE (SS#1)	1
115	MWH	UNIT 2 STATION SERVICE (SS#2)	2
116	MWH	UNIT 3 STATION SERVICE (SS#3)	3
117	MWH	UNIT 1 GROSS GENERATOR OUTPUT	1
118	MWH	UNIT 2 GROSS GENERATOR OUTPUT	2
119		CWF FLOW RETURNING TO BUNKER STORAGE	COMMON
120	LB/HR	ATOMIZING AIR FLOW	COMMON
121	SP.G.	CWF DENSITY	
122		FLY ASH	
123		CWF TEMPERATURE AND CHEMICAL ANALYSIS	

NOTE

DUCTING HAS BEEN EXPLODED FOR CLARITY

THIS DOCUMENT IS
FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION

NOTES

DRAWN | DATE | APPROVALS
CHECKED
CHIEF DRAFTSMAN
DESIGNED
Project Eng | Project Manager | Mgr. Eng. & Constr.
SCALE

CONSULTANT

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION
Fredericton N.B.

PROJECT CHATHAM PLANT

TITLE [illegible]

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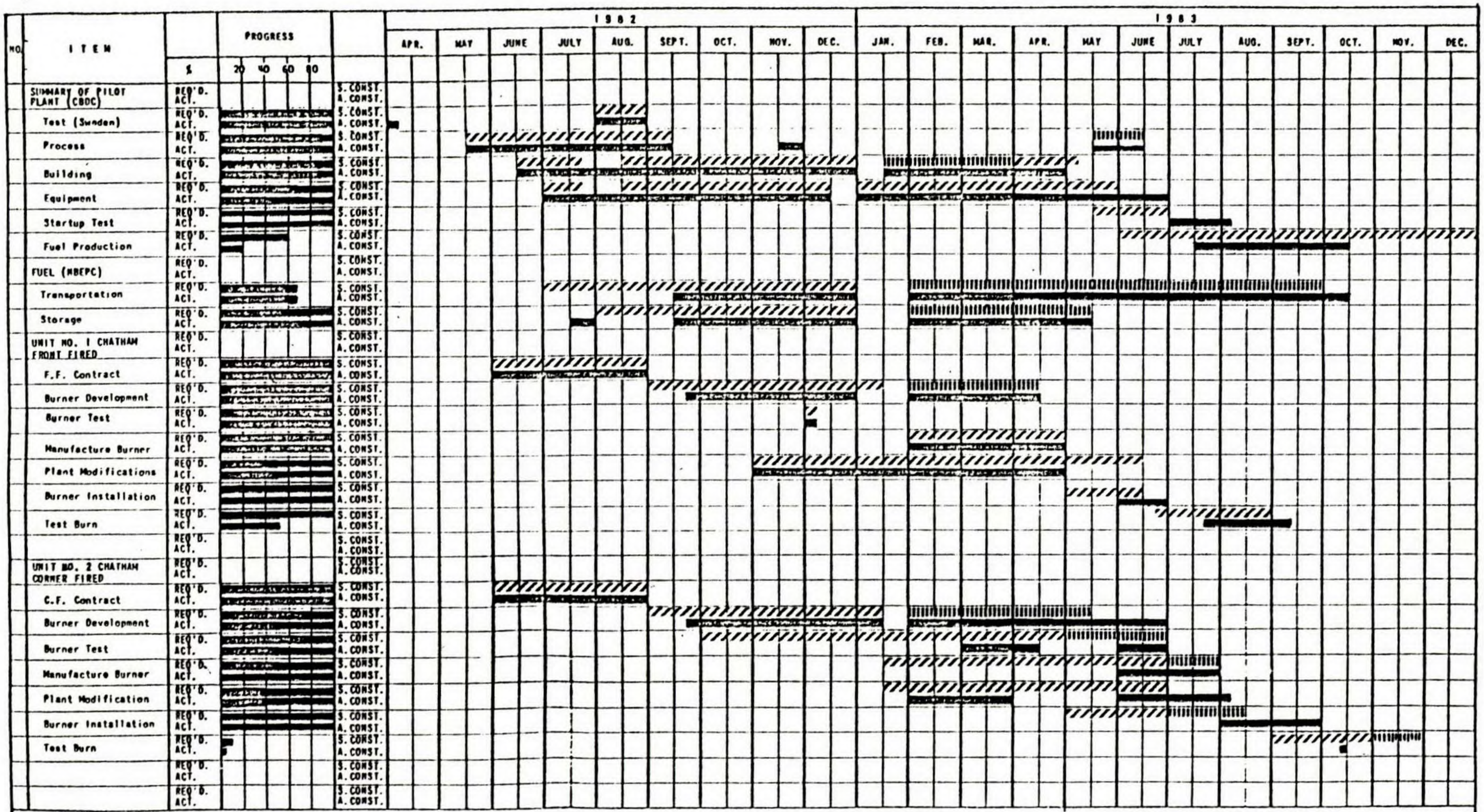


THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

JOB SCHEDULE AND PROGRESS REPORT

LEGEND:

- ///// - SCHEDULES
- IIIIIIIII - RESCHEDULES
- ▬ - WORK COMPLETE
- S. CONST. - SCHEDULED CONSTRUCTION
- A. CONST. - ACTUAL CONSTRUCTION

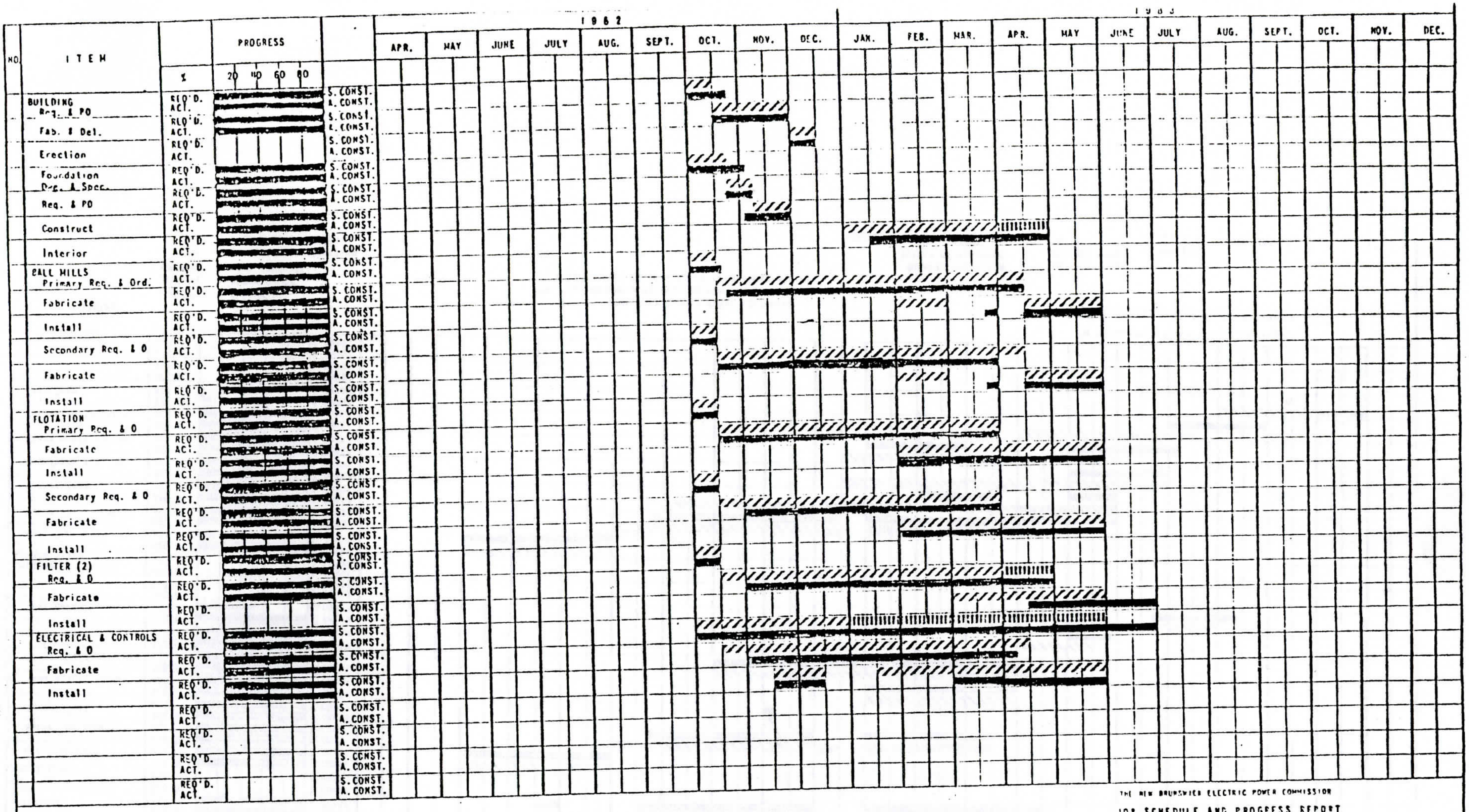
NOTE: AT DATES OF ISSUE THIS REPORT SHOWS ESTIMATED TIME THAT FUTURE WORK WILL BE PERFORMED. THESE TIMES WILL BE REVISED AS CONDITIONS DICTATE.

PROJECT: SUMMARY SHEET FOR BURNER DEVELOPMENT COAL - WATER

JOB: 667 101 4400
667 201 4400
667 301 4400

PROJECT MANAGER: D.M. RANKIN

SHT 1 of 5



LEGEND:

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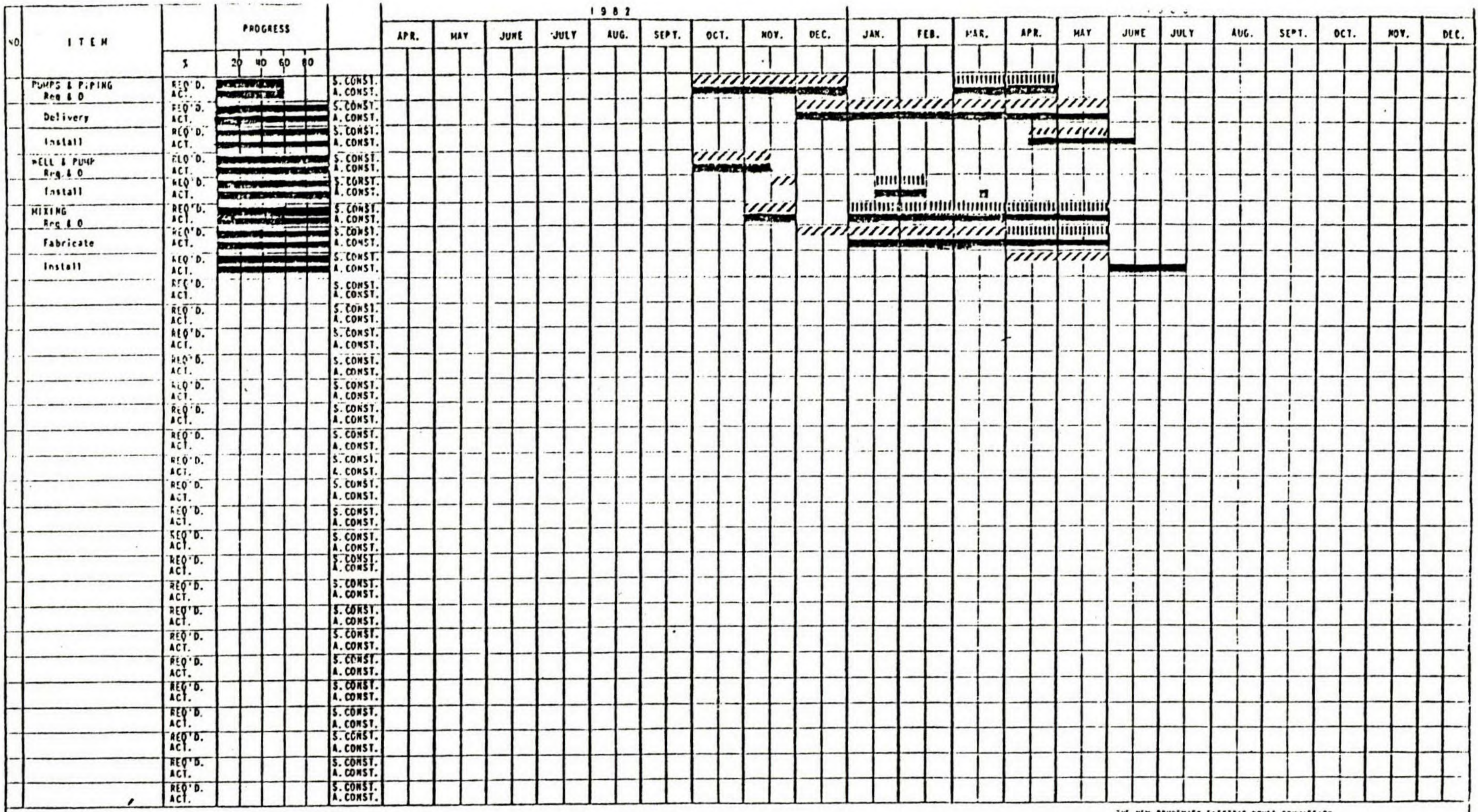
THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

JOB SCHEDULE AND PROGRESS REPORT

PILOT PLANT FOR FUEL PREPARATION
BURNER DEVELOPMENT
PROJECT: COAL - WATER JOB: ECT 101 4402 PROJECT MANAGER: D.M. RANKIN SHT. 2 of 5



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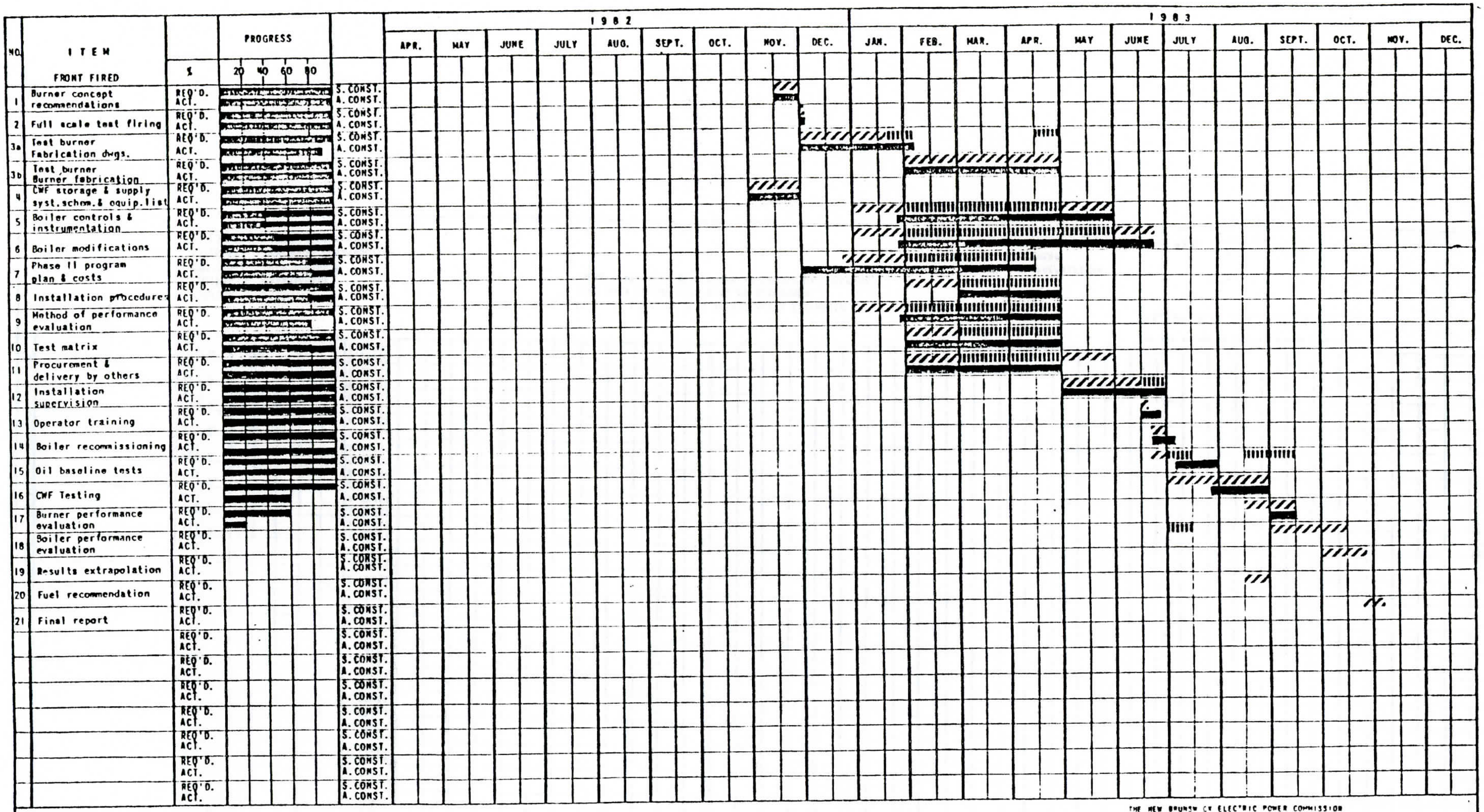
THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

JOB SCHEDULE AND PROGRESS REPORT

PILOT PLANT FOR FUEL PREPARATION
BURNER DEVELOPMENT
PROJECT: COAL - WATER JOB: 667 101 4400 PROJECT MANAGER: D.M. RANKIN SHT. 1 of. 5



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▨ - SCHEDULES
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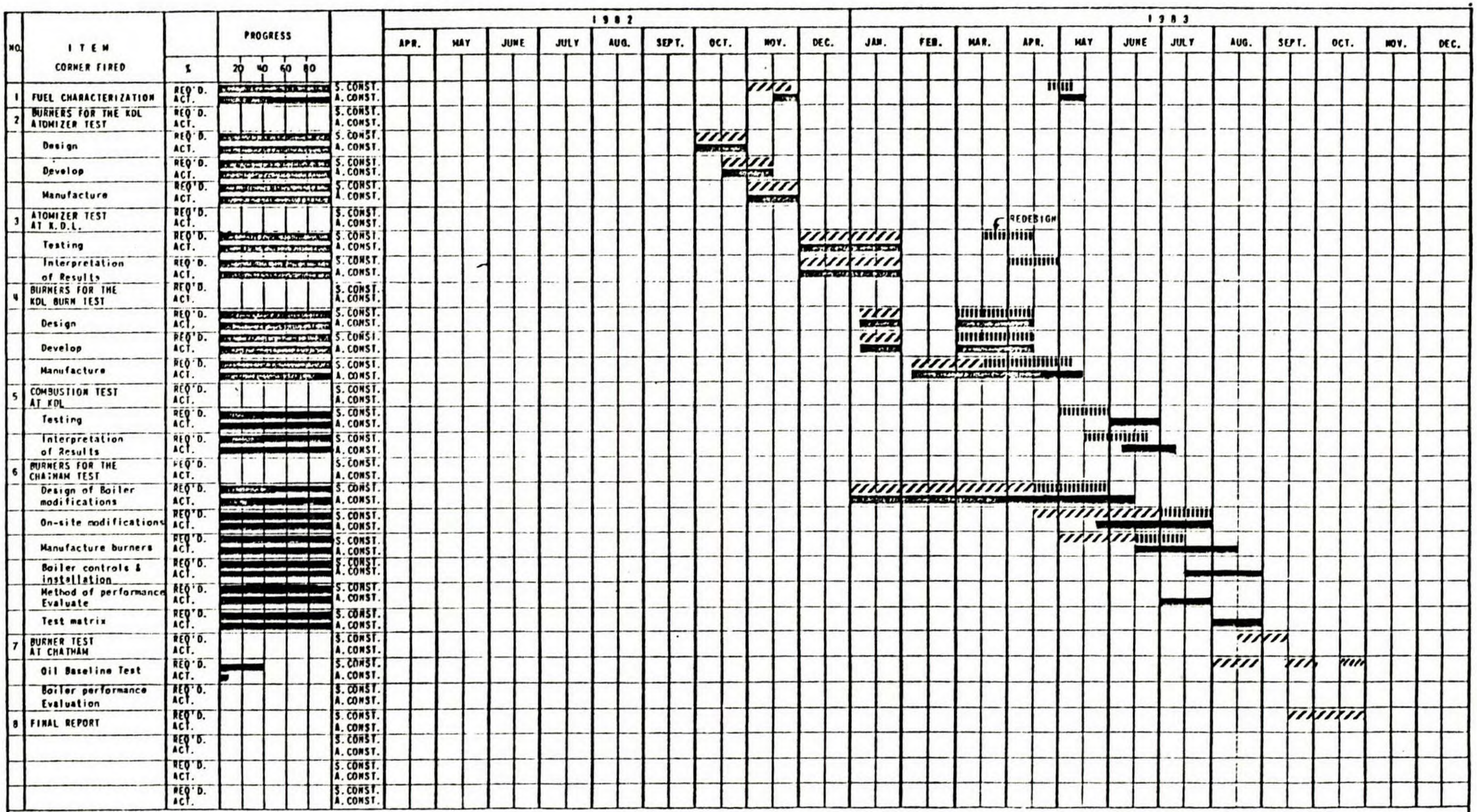
THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

JOB SCHEDULE AND PROGRESS REPORT

PROJECT: FRONT FIRED BURNER DEVELOPMENT FOR COAL/WATER FUEL
JOB: 667 201 4400
PROJECT MANAGER: D.M. RANKIN
SHT 4 of 5



LEGEND:

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THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

JOB SCHEDULE AND PROGRESS REPORT

PROJECT: CORNER FIRED BURNER DEVELOPMENT FOR COAL/WATER FUEL JOB: 867-301-[illegible] PROJECT MANAGER D. M. [illegible] 5 , 5

3-422b

Chatham Coal Water
Burner Development
Progress Report

THE NEW BRUNSWICK ELECTRIC POWER COMMISSION

COAL WATER BURNER DEVELOPMENT

OCT. 3rd, 1983

1. SUMMARY

Tests on Unit I have been interrupted pending resolution of coal grinding problems at the Sydney Pilot Plant.

Unit II modifications are almost completed and the unit will be starting up within in a few days.

A modification program is underway at the CBDC Fuel Plant in Sydney to improve the grinding and screening portion of the pilot plant.

2. PILOT PLANT

The pilot plant has operated at various loads up to about 5 tonnes of coal per hour. Problems with respect to the grinding and screening have been encountered; which have prevented the plant from producing top quality fuel. An active program is now underway to overcome this problem.

Some of the actions taken or underway include:

2.1 Change of the grinder balls to a different grade of steel.

2.2 Install screens in the fuel discharge lines.

2.3 Install a second sive bend.

2.4 Modify the startup procedure for the plant.

2.5 Complete review of the grinding screening circuit with Carbogel, Foster Wheeler (Carbogel Liscencee) and others.

3. FUEL

The fuel is being transported from Sydney to Chatham by Rail Tank Car. No defaulties are being experienced in unloading.

.....2/

4. CHATHAM I

Front Fired Unit

This unit was fired for several hundred hours on C.W.M. Fuel. The first burns were good but we were unable to achieve full load and were unable to improve the burn.

Several nozzle materials were checked and tungston carbide was selected. The ceramics proved to wear very well but were subject to cracking.

The test program has been modified in co-operation with the CBDC to relate the actual car load of fuel to the burning characteristic of that particular car.

5. CHATHAM II

Corner Fired Unit

The modification to the unit are nearing completion and the unit is being started up on oil very shortly. A test program has being prepared for the unit.

6. SUMMARY

The test programs are being adjusted to achieve the maximum benefits from the test.

Formal performance tests have been postphoned pending resolution of the fuel manufacture problem.

Dave Rankin