

226/15
1st February, 1958.NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCEPower Supply Plant for the Magnet Excitation
of the 7 GeV Proton Synchrotron

1. The power supply plant for exciting the magnet of the 7 GeV Proton Synchrotron mainly comprises two motor-alternator sets of a combined output of 120 M.V.A. coupled through transformers to a multi-bank ignitron converter set capable of supplying a maximum direct current of 8,000 amperes to the magnet winding of the machine. A large flywheel is used in conjunction with the motor-alternators to minimise the size of driving motors and the power fluctuations on the supply network.
2. After a design study and preliminary technical discussions with industry, a complete and detailed specification was issued inviting separate tenders for;

- (a) The rotary machines and associated control gear,
- (b) The converter plant, transformers and associated ancillaries.

It was apparent at the outset that only B.T.H. and Brown-Boveri would be able to tender for the complete plant since they were the only manufacturers having suitable ignitron valves to offer. Despite the obvious advantages of one firm supplying the entire equipment it was considered desirable to invite wider competition for the rotary machines. Accordingly the specification was issued to:

Messrs. British Thomson-Houston Co., Ltd.
The English Electric Company, Ltd.
Messrs. Metropolitan-Vickers Company, Ltd.
The General Electrical Company, Ltd.
Messrs. C. A. Parsons, Ltd.
The British Brown-Boveri Co., Ltd.

In view of the higher relative importance of the converter plant the specification made it quite clear that if separate contracts were issued the successful tenderer for the converter plant would be regarded as the main contractor; tenderers for the converter plant were asked whether they would co-operate with another supplier of the rotary plant.

3. Four tenders were returned on the closing date and these are summarised in Appendix I. The offers made could not be directly compared, and it was necessary to adjust figures to allow for various omissions in some tenders and extra expense, on other aspects of the accelerator, which would be incurred with others. Details of the adjustments are given in Appendix II.

Appendix III gives the amended prices.

It will be noted that the Brown-Boveri Co., Ltd. give alternative offers, one for equipment entirely of Swiss manufacture, and other combinations for equipments partly British, partly Swiss.

4. The B.T.H. Company make a comprehensive offer but are not prepared to subdivide. Their offer, although comparable with others technically, subject to ignitron tests which have not yet been completed, does not justify the higher price and for that reason is not recommended.

The converter plant offered by the British Brown-Boveri Co., Ltd., is technically satisfactory and we therefore recommend its acceptance.

5. Despite our best efforts on the rotary plant, it cannot be said that any of the offers is completely satisfactory as it stands. The power plant is of an unusual nature; some of the uncertainties cannot be completely resolved until long after a contract has been placed, and the contractor has had time to complete a good proportion of his detailed design. The most definite offer is that of the Brown-Boveri Company, who have already designed the smaller C.E.R.N. plant, but we are unable to recommend this since it appears to us to give insufficient safety margin on the ratings required for our machine. All the manufacturers assure us that our specification will be met, but whichever offer is accepted, changes in technical specification and consequent variation of price may be found necessary.

We have carefully examined the tenders in the light of these factors, and feel that a choice must be made without delay in order to progress further. The offer of the English Electric Company is the most attractive.

Separate discussions have been held with the English Electric Company and British Brown-Boveri, and these companies have reassured us that if the project should be split between them there would be full technical collaboration from design stages to final commissioning of the equipment, with Messrs. Brown-Boveri taking the lead.

6. It is therefore recommended that:

(a) The British Brown-Boveri Co., Ltd., be given the order for the converter plant, using British transformers, at a cost of £562,700,

i.e.	£149,500	Sterling Cost
	£413,200	Swiss currency.

(b) A.E.R.E. be authorised to call a meeting with Messrs. Brown-Boveri and the English Electric Co., to discuss the technical and contractual aspects of the work, and the interconnection of the specifications for the converter plant and the rotary plant.

(c) A contract be placed with The English Electric Company for the rotary plant at £440,996, if the outcome of this meeting is judged to be satisfactory by A.E.R.E.

7. The total cost would then be £1,003,666. In the global estimates for the project, a provisional figure of £1,100,000 was included for power supplies.

Approval is sought for this amount, the difference of £96,334 being held in reserve against items requested in the specification and not put forward in any of the offers, and for variations which may be found necessary as the detail design of the combined system develops. It is proposed that the first £25,000 of any additional expenditure be subject to the approval of the Project Committee and any expenditure beyond this amount be subject to the approval of the General Purposes Committee.

Summary

Approval is sought for:

1. The order for the converter plant to be given to Messrs. British Brown-Boveri at a price of £562,700.
2. The order for the rotary plant to be given to Messrs. English Electric at a cost of £440,966, subject to a satisfactory outcome of a meeting between the two proposed contractors and A.E.R.E.
3. A possible total expenditure on the power supply plant of £1,100,000.
4. The Project Committee to authorise additional expenditure of £25,000 where this is shown to be necessary.

D. W. Ery
Chairman, Project Committee

APPENDIX I

ANALYSIS OF TENDERS AS RECEIVED

Firm	English Electric Co.	General Electric Co.	British Thomson-Houston Co.	British Brown-Boveri Co.		
				All Swiss Manufacture	Part Swiss Max. British	Part Swiss British Transformers
Motor Regulation	None	None	None	Scherbius Control	Scherbius Control	Scherbius Control
Description (Rotary Plant)	Rotary Machines 3,000 r.p.m. 2 Flywheels Machine Switch & Control gear	Rotary Machines 3,000 r.p.m. 4 Flywheels Machine Switch & Control Gear	Rotary Machines 1,000 r.p.m. 2 Flywheels Machine Switch & Control gear	Rotary Machines 3,000 r.p.m. 1 Flywheel Machine Switch & Control gear Scherbius Machines	Alternators (Richardson -Westgarth) Swiss	ALL Swiss
Delivery	30 months	27 months	30 months	33 months	32 months	33 months
Price	£440,966	£452,660	£459,000	£436,600	£343,100 Brit. +£240,600 Swiss.	£436,600
Description (Converter Plant)	No quotation	No quotation	Ignitron Converter Control Transformers Magnet Switch	Excitron Converter Control Transformers Magnet Switch	Swiss (Bruce Peebles Co.) Swiss	Swiss (Bruce Peebles Co.) Swiss
Delivery			30 months	28 months	32 months	32 months
Price			£574,950	£555,650	£444,500 Brit. +£401,650 Swiss.	£444,500 Brit. £401,650 Swiss.
Total				£992,250	£1,129,850	£982,750
Total Price including Import Duty				£1,166,000	£1,242,240	£1,129,440

APPENDIX II

Corrections to Price Analysis

1. Only BB Co. include £13,000 for concrete block foundation so other tenders for rotary plant are increased by this amount.
2. Only B.B.C. include for Cables and Pipe Work. £45,000 for cables and a hidden amount assumed £10,000 for pipes. We have sub-divided this as £20,000 for Rotary Plant and £35,000 for Converter Plant.
3. All except B.B.C. include for Tap Changing on Exciter Transformer -- £3,000 adjustment.
4. B.T.H. omit Air Compressor and supervisory gear worth £3,000.
5. English Electric Co. need 110 ton crane, add £20,000 for cost of crane and building over and above 60 ton cost.
6. Gen. Electric Co., and B.T.H. need 75 ton crane, add £5,000.

APPENDIX III

PRICES QUOTED TO A COMMON BASIS

Firm	English Electric Co.	General Electric Co.	British Thomson-Houston Co.	British Brown-Boveri Co.		
				All Swiss	Part Swiss Max. British	Part Swiss British Transformers
Rotary Plant	£493,966	£490,660	£500,000	£459,600	£606,700	£459,600
Converter Plant	£562,700*	£562,700*	£909,950	£555,650	£546,150*	£546,150*
TOTAL PRICE	£1,056,666	£1,053,360	£1,409,950	£1,015,250	£1,152,850	£1,005,750
PRICE INCLUDING IMPORT DUTY	£1,129,851	£1,126,545	£1,409,950	£1,189,400	£1,265,243	£1,152,443

*BBC Swiss Converters and Bruce Peebles Transformers