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NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE

GENERAL PURPOSES COMMITTEE

Revision of Nimrod Estimate

(Report by the Nimrod Project Committee)

15th October, 1959.

RSPC/P.52

NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE

GENERAL PURPOSES COMMITTEE

REVISION OF NIMROD ESTIMATE

Paper by the Chairman of the Project Committee

1. INTRODUCTION

1.1 In the past, it has been the practice to revise the estimates only on the basis of positive information such as firm contract prices or known changes in requirements. This was good practice while designs were incomplete and estimates inevitably approximate. However, the design phase is now well advanced and the basis of estimating is consequently becoming more reliable.

1.2 The attached table shows a comparison between the latest revised estimate and previous estimates shown in the Quarterly Statements. The notes at the foot of the table state briefly the reasons for the increases which have been approved by the Committee in the past.

1.3 The latest revised estimate of £8.29M shows an increase of £0.376M over the sum of £7.922M at present approved by the Treasury and an increase of £1.268M over the preliminary estimate of £7.03M made in 1957.

2. PLANT ESTIMATE (MACHINE ONLY)

2.1 Of the total estimate of £5.778M, a sum of £4.1M relates to contracts already placed. The balance of £1.678M is the estimated cost of outstanding items based on the most up-to-date design information.

2.2 The revised Plant Estimate shows an increase of £0.296M over the Treasury approval, made up as follows:-

	<u>Present</u> <u>Approved</u> <u>Estimate</u> £M	<u>Revised</u> <u>Estimate</u> £M	<u>Increase</u> £M
Magnet	2.652	2.823	0.171
Vacuum System	0.780	0.905	<u>0.125</u>
			<u>0.296</u>

These increases are explained in detail in Appendices I and II.

2.3 The Power Supplies Estimate is unchanged but a redistribution is proposed within the total of £1.3M. Details are given in Appendix III.

3. BUILDING ESTIMATE (CIVIL AND M. & E. WORK)

Of the total estimate of £2.52M, the value of work done and equipment ordered now amounts to approximately £1.68M. The balance of £0.84M is an estimated figure, taking account of the latest information. The revised Building Estimate shows an increase of £0.08M over the Treasury approval; this increase relates solely to M. & E. work and is discussed in detail in Appendix IV.

4. RECOMMENDATIONS

It is recommended that:

- (i) The Magnet Estimate be increased to £2.823 M being an increase of £0.171 M on the approved estimate.
- (ii) The Vacuum System Estimate be increased to £0.905 M being an increase of £0.125 M on the approved estimate.
- (iii) The new composition of the Power Supplies Estimate be approved.
- (iv) The M. & E. Estimate be increased to £0.667 M being an increase of £0.08 M on the approved estimate.

D.W. FRY
Chairman,
Project Committee

TABLE SHOWING COMPARISON OF APPROVED ESTIMATES

	Original Treasury Approval	QUARTERLY STATEMENTS							Present G.P.O. Approval	Latest revised Estimate
		No. 1 12.10.57	No. 2 4.1.58	No. 3 31.3.58	No. 4 21.6.58	No. 5 19.9.58	No. 6 21.1.59	No. 7 31.3.59		
PLANT										
Magnet	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.60	2.652	2.823
Injector	0.30	0.30	0.30	0.30	0.30	0.45	0.45	0.45	0.450	0.450
R. F.	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.150	0.150
Vacuum	0.40	0.40	0.40	0.40	0.46	0.50	0.78	0.78	0.780	0.905
Power	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.300	1.300
Supply	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.150	0.150
Controls	0.10	0.10	0.10	0.10	0.10	-	-	-	-	-
Cooling										
PLANT TOTAL	5.00	5.00	5.00	5.06 ^c	5.15 ^e	5.15 ^e	5.13 ^g	5.43	5.482 ^j	5.778
BUILDINGS										
Architects	1.40	1.34	1.34	1.48	1.48	1.46	1.51	1.53	1.591	1.591
L. & E.	0.40	0.54	0.55	0.55	0.56	0.56	0.56	0.57	0.587	0.667
Fees	0.10	0.15	0.15	0.23	0.23	0.23	0.23	0.23	0.232	0.232
Furniture	-	-	0.03	0.03	0.03	0.03	0.03	0.03	0.030	0.030
BUILDING TOTAL	1.90	2.03 ^a	2.03	2.21 ^b	2.29 ^d	2.28 ^f	2.33 ^h	2.36 ⁱ	2.440 ^k	2.520
GRAND TOTAL	6.90	7.03	7.03	7.21	7.35	7.43	7.46	7.79	7.922	8.298

a) Cost of Arcon Building and revision of Estimates (Paper NI GP 57.3 refers)

b) Revised Estimates including cost of furniture

c) Revised estimates for Vacuum Pumps (Paper NI GP 58.6 refers)

d) Industrial Groups fees included

e) Revised Estimates on Injector. £100,000 re-allocated from Cooling system as follows: £60,000 to Injector and £40,000 to Vacuum system

f) Slight decrease due to re-estimating

g) Redesign of Vacuum Chamber. The design information was not sufficiently complete to allow a firm estimate at this stage

h) Additional works approved by Project Committee listed in Appendix 1 of Quarterly Statement No. 6

i) Re-estimating following approval of design details and various additional works listed in Appendix 1 of Quarterly Statement No. 7

j) Increase due to cost of Build-up Plates and Magnet Coil improvements (Paper NI GP 59.17 refers)

k) Additional works approved by the Project Committee listed in Appendix V of Quarterly Statement No. 7. Increase in estimate for main surface water scheme. (Paper NI GP 59.19 refers)

REVISION OF NIMROD PLANT ESTIMATESMAGNET1. INTRODUCTION

The latest revised estimate shows an increase of £171,000 over the approved sum of £2.652M. It will be recalled that the last Quarterly Statement dated 31.3.59 predicted that some increase in the estimate for the Magnet would be necessary.

2. ADDITIONAL WORK ON MAGNET SECTORS

Paper No. PSPC/P47 details the additional costs on Sankey's contract and seeks approval for an increase in the value of this contract of £94,529.

The sum available in the approved estimates for modifications and additions to the sectors is £35,400 and if the amendment to the Sankey contract is approved, the increase in the Estimate for sectors amounts to £59,129.

3. ADDITIONAL COST OF OCTANT END STRUCTURES

The revised estimate is £95,000 which shows an increase of £70,000 over the provision for this item in the Approved Estimate.

A re-assessment of the effects of the large magnetic forces involved at the ends of the magnet octants has resulted in heavier main brackets and the use of end restraining brackets. To minimise interference with the magnetic flux, the design of the main brackets now incorporates stainless steel. Experience with model magnets has contributed to these changes.

The re-design of the main vacuum chamber has resulted in more complex supports for the end pole pieces which are now housed within the outer component of the vacuum chamber.

The additional cost of £70,000 is made up as follows:-

	<u>Approved Estimate</u>	<u>Revised Estimate</u>
	£	£
Main Brackets	12,000	55,000
End Restraining Brackets	4,000	29,000
End Pole Piece Supports	1,000	5,000
Concrete beams & retaining structure	8,000	6,000
	<u>£25,000</u>	<u>£95,000</u>

4. ADDITIONAL COST OF COIL CLAMPING SYSTEM

The revised estimate is £140,000 which shows an increase of £60,000 over the provision for this item in the approved estimate.

The disastrous coil failure on the Brookhaven Cosmotron was analysed in collaboration with Brookhaven staff, and numerous modifications made to the Nimrod Coil Clamping System as a result. This situation was aggravated by the re-design of the Vacuum Vessel. These changes have increased the estimated cost of the first three items listed below. In addition, stronger and more expensive materials have now been specified for the coil clamping bridge in the magnet throat in order to leave the maximum possible space for Nuclear Physics Experiments. Finally the lowest acceptable tender for the pressure pads is more than the approved estimate.

APPENDIX I (Continued)

The additional cost of £60,000 is made up as follows:-

	<u>Approved Estimate</u>	<u>Revised Estimate</u>
	£	£
Throat coil clamping bridge	7,000	29,000
Lip conductor clamping	67,000	83,000
End coil clamping	3,000	17,000
Pressure Pads	<u>3,000</u>	<u>11,000</u>
	<u>£80,000</u>	<u>£140,000</u>

5. ADDITIONAL COST OF SECTOR POSITIONING GEAR

In order to meet the Sector installation programme it was necessary to double the amount of sector jacking and manoeuvring gear. This together with additional trolleys for moving this equipment has resulted in an increase of £7,000 over the approved estimate of £10,000.

6. SAVINGS ON APPROVED ESTIMATE

The placing of a contract for the main pole pieces and provision for subsequent amendments amount to £250,000. The sum allowed in the approved estimate was £275,000.

7. SUMMARY

The additional costs on the Magnet Section of the Estimate are as follows:-

	£
Magnet Sectors	59,000
Octant End Structure	70,000
Coil Clamping System	60,000
Sector Positioning Gear	<u>7,000</u>
	196,000
Reduction in Estimate for Main Pole Pieces	<u>25,000</u>
<u>Net Increase</u>	<u>£171,000</u>

REVISION OF PLANT ESTIMATEVACUUM SYSTEM1. INTRODUCTION

The latest revised estimate shows an increase of £125,000 over the approved sum of £20,784. Of this increase £115,000 will be absorbed by the additional cost of the Main Vacuum Chamber.

2. MAIN VACUUM CHAMBER

2.1 The complete change of approach to the problem of the main vacuum chamber has involved an extensive design programme. In order to develop production techniques in time for manufacture of the component sections it was necessary to place a contract with a manufacturer who had wide development resources in the special techniques involved.

2.2 A contract was therefore placed with Marston Excelsior, Ltd. for the development and manufacture of one complete prototype section. This contract has a limit of liability of £100,000.

2.3 Prior to the placing of the contract an estimate of overall cost of £325,000 was made based on preliminary information. Marston Excelsior, Ltd. at our request have re-examined the overall costs; their present estimate is £440,000.

2.4 The comparison between the original and the new estimate is as follows:-

	<u>Original estimate</u> £	<u>New estimate</u> £
Development work	30,000	55,000
Tools and plant	60,000	150,000
Production of one complete prototype section	<u>25,000</u>	<u>25,000</u>
	115,000	230,000
Manufacture of 8 production sections	<u>210,000</u>	<u>210,000</u>
	<u>£325,000</u>	<u>£440,000</u>

The price to be paid for the eight production sections will have to be negotiated with the contractor when he is in a position to quote.

The tools for the production of the prototype section will be used in manufacture of the remaining sections.

2.5 A separate paper PSPC/P55 to the General Purposes Committee outlines the case for the additional expenditure, and recommends that the limit of liability on the contract with Marston Excelsior be increased from £100,000 to £230,000.

3. ADDITIONAL PUMPING EQUIPMENT

As a consequence of changing to a double walled chamber it was found necessary to provide an additional roughing pump scheme for the outer chamber at a cost of £10,000. This scheme was approved by the Project Committee. (PSFC/M17 refers)

4. SUMMARY

The additional costs on the Vacuum System Section of the estimate are as follows:-

	£
Main Vacuum Chamber	115,000
Additional Pumping Equipment	10,000
	£125,000

REVISION OF NIMROD ESTIMATES

POWER SUPPLIES

1. INTRODUCTION

Although no increase in the Power Supplies Estimate is anticipated, it is proposed to make certain changes in the composition of the estimate within the approved sum of £1.3 M. These changes are enumerated below:-

2. SATURATING CHOKE

The approved estimate includes £200,000 for a saturating choke. The function of this choke, namely to control the rate of rise of magnetic field near injection, has been largely achieved by additional equipment ordered on the Brown-Boveri contract at a cost of £36,000. It is now believed that the large choke originally conceived will not be required. It is, however, considered desirable to retain a sum of £20,000 in the estimate to cover further development connected with the rate of rise of the magnetic field near injection.

3. RIPPLE FILTERING SYSTEM

A ripple filtering system is necessary to make the best use of the available aperture and to obtain the maximum proton current. The full magnitude of the problem is now known and schemes are being prepared. It is not possible to submit a detailed estimate at this stage, but it is proposed to insert a notional sum of £80,000 in the estimates. A separate paper will be submitted to the General Purposes Committee as soon as details are known.

4. MOTOR ALTERNATOR FOUNDATION BLOCK

A token sum of £10,000 was allowed in the original estimate for the foundation block. The design is not yet complete but the dynamic forces involved have made this an extremely difficult problem to resolve and it is now believed that the final cost will be much greater. It is therefore proposed to insert a notional sum of £40,000 in the estimate to cover the cost of this foundation. A separate paper will be submitted* to the General Purposes Committee as soon as the final estimate is known.

5. ADDITIONAL REQUIREMENTS

Paper PSFC/P.56 details a number of additional requirements considered necessary to achieve a higher standard of safety and reliability mainly on the rotating machinery in the light of experience with the operation of the Bevatron. These amount to £34,000.

*This will be an urgent item and will come up before the next regular meeting of the Committee.

6. SUMMARY

APPENDIX III (Contd.)

The revised estimate for the Power Supplies is as follows:-

Approved Estimate	£1,300,000
Notional cost of Ripple Filtering equipment	80,000
Additional cost of Alternator Foundation (notional)	30,000
Reserve sum for varying rate of rise of magnetic field	20,000
Additional requirements for Safety and reliability	34,000
	1,464,000
Less savings on the Saturating Choke	164,000
	£1,300,000

14th October, 1959

PSPC/P.52

Appendix IV

REVISION OF BUILDING ESTIMATES
(COVERING CIVIL AND M. & E. SERVICES.)

1. INTRODUCTION

The latest revised estimate shows an increase of £80,000 over the approved estimate of £2.440 M. This increase is due solely to the M. & E. services, the revised estimate of which is now £0.667 M against the approved estimate of £0.587 M. The Civil Estimates presented by the Chief Architect are unchanged at £1.591 M.

2. SAFETY REQUIREMENTS

Increases are necessary in respect of the safe handling of hydrogen for which special measures have been recommended by H.M. Factory Inspectorate and other experts at a cost of £9,000. In addition, other minor increases related to safety, for example, emergency lighting in tunnels, amounts to £3,000.

3. ADDITIONS AND ALTERATIONS TO M. & E. SERVICES FOR MACHINE INSTALLATION.

It has been our experience in dealing with complex installations, particularly large accelerators of an experimental character, that many minor design requirements have to be embodied as installation progresses. No adequate allowance has been made for such changes in the estimates prepared by Messrs. Merz and McLellan and it is considered essential that a reserve of £25,000 should be made available for this.

4. TEMPORARY WORKS

During the construction period, it is proving necessary for the Group to take over occupation of buildings prior to permanent services being available. Moreover, buildings which will not be required for their ultimate purpose until the machine is complete or nearing completion, are being adapted for other functions. This calls for considerable temporary services and insufficient allowance was made for this in the original estimate. The increase is £25,000.

The buildings cannot be handed over until the completion of the machine and therefore this work cannot be carried out on a running account of the Rutherford Laboratory for Minor Works.

5. WATER TREATMENT PLANT

It was necessary to postpone this item of plant to prevent over-committing the estimates for essential service requirements. The water treatment plant for the cooling tower will eliminate phosphate dosing of the make-up water and appreciably decrease the amount of water used. The saving is such that the capital cost of £12,000 would be repaid in about three years.

Appendix IV (Continued)

6. SOUND INSULATION

This item was also postponed to allow more urgent items to be ordered and thus keep within the approved estimates. The case for the sound insulation of the Alternator Building is that the alternator and flywheels will produce a noise level which the building itself will not sufficiently attenuate to prevent general disturbance in nearby offices and laboratories

7. SUMMARY

Safety requirements	..	£12,000
Additions and alterations to M. & E. services for machine installation	..	£25,000
Temporary works	..	£25,000
Water Treatment Plant	..	£12,000
Sound Insulation	..	6,000
		£.80,000