IN CONFIDENCE

R.R.2(65/66)
November, 1965

SCIENCE RESEARCH COUNCIL

RESEARCH REACTOR COMMITTEE

Report of the Working Party set up to consider proposals for the Development of Facilities at the Scottish Reactor Centre

1. Introduction

The terms of reference of the Working Party are stated in the minutes of the 24th meeting of the Research Reactor Committee (NIR.M/24). They are:

(i) to investigate more thoroughly the proposal for developments at the Scottish Reactor Centre, in the light of concern expressed by the S.R.C. at lack of communication between themselves and the Consortium of Scottish Universities.

(ii) to comment on the proposals to modify the reactor.

(iii) to make recommendations on the development of the work at the Centre in the light of the general policy on neutron beam research formulated by Professor Mitchell's panel.

The Working Party met on two occasions; on 29th September 1965 at East Kilbride, when it was able to discuss the proposals with Dr. Wilson and his staff, and on 4th November 1965 at A.E.R.E. Mr. Woolf, of the U.G.C. secretariat, attended the second meeting.

2. The current situation at the Scottish Reactor Centre

2. a) Staff

The present staff is as follows:

Director
Deputy Director
4 Scientific Staff
2 Reactor Operators
6 Technicians
2 Janitors
2 Typists

2. b) Teaching

Courses in reactor physics, nuclear engineering, health physics, radiochemistry and the use of radio-isotopes are given at the Centre. In a few cases these are at postgraduate level, but the majority are at under-graduate level. The courses are in most cases given exclusively at the Centre by the staff of the Centre, although some preliminary courses are given by university staff at individual universities. Dr. Wilson told the Working Party that many departments in the universities forming the Corsortium did not have the staff to teach, for example, nuclear engineering or reactor physics, and

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that they have requested the Centre to take complete responsibility for such courses.

2. c) Research

The research at the Centre is developing very much as expected, and the reactor appears to be fulfilling a real need in the production of isotopes for tracer work and in activation analysis. There does not appear to be any conflict with the recommendations of Professor Mitchell's panel in the beam work which is at present in progress.

3. Future Developments at the Centre

The proposals are set out in an application from the Consortium of Universities to D.S.I.R. in January 1965 attached. We summarise the proposals below, adding our comments where necessary.

3. a) Staff

Additional staff are requested as follows:

4 Academic members of staff
5 Technicians
Junior Technicians (probably two or three)

The case for additional staff must be judged in relation to the policy adopted for teaching at the Centre; this is discussed below. (The additional technicians are required largely for teaching laboratory work). The Working Party felt that since the proposed appointments will fall within the next quinquennium, it will be a matter for the Consortium to consider them in relation to academic developments in the individual universities.

3. b) Teaching

The teaching courses mentioned under 2.b) above clearly make large demands upon the time of the reactor staff. A comparison with the London and the Liverpool/Manchester reactor sites is relevant here. At both of these sites the reactor staff spend less time in formal teaching; if they give undergraduate courses, they do it at the University or College concerned, usually as part of an already established course. Whilst it is the practice to give demonstrations at the reactor, most departments prefer to deal with the teaching themselves. Specialised short courses (e.g. in the use of radioisotopes) are also held at the universities, where the facilities for dealing with large numbers of students are better.

A further point arises in connection with teaching at such an establishment in that academic members of staff are expected to pursue their own research, which in this case will probably be connected with the reactor. Whilst this may strengthen the research at the reactor, it may absorb facilities which could otherwise be used by members of individual university departments. It could be argued that this may inhibit feed back of research from the reactor to the departments concerned; on the other hand better advice from the reactor staff to intending researchers would certainly be available.

3. c) Research

The proposals for future research which are mentioned in papers supporting the application do not, with one exception, conflict with the recommendation of Professor Mitchell's panel. This exception is

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the cold neutron source, which we understand is in any case being reconsidered by Professor Allen together with the reactor staff.

In considering the application for equipment we have made a division into three categories where financing is concerned. Firstly there are those items which may be considered as a reasonable extension of the equipment provided by D.S.I.R. to establish the Centre. Secondly there are items which are associated with the proposed extension of the buildings, and which would normally be provided under an equipment grant for a new building. Thirdly there are those items which we feel are more properly the subject of a specific research grant from the S.R.C. After discussion with Dr. Wilson we have arrived at the division shown in the Appendix. We believe that both neutron generators fall into the category of special research applications, and would add that the one proposed for activation analysis may be affected by current discussions in the S.R.C. concerning the provision of national centres for instruments and analytical services. Subject to the result of these discussions, it is our opinion that a reactor centre is a suitable site for such a service.

The Working Party did not consider the scientific case for the provision of mass spectrometry equipment at the Centre, since this is already under consideration by the N.E.R.C. If the proposal is supported, however, we feel that it would be appropriate for the equipment to be sited at the Centre. At the same time, it must be stressed that such developments, taken together with the proposed increase in academic staff at the reactor, point towards the growth of a research centre with greater independence than was perhaps intended in its original conception.

3. d) Additional Buildings

We have considered the proposals on the assumption that the present policy on teaching at the Centre is continued in the future. We do not feel competent to comment on the space allocated to mass spectrometry, but we agree with the remainder, with the following exceptions.

Lecture Theatre. We are not convinced that a lecture theatre for 100 people is necessary, particularly since such numbers could not be accommodated for subsequent demonstrations or laboratory classes. Rather than transporting such numbers to the reactor purely for lectures, one must consider whether it would not be better for the reactor staff to visit the universities. We understand that a large lecture theatre is available at N.E.L. for use on special occasions.

Mechanical Engineering Laboratory. We would expect that mechanical engineering work associated with nuclear engineering would be accommodated in the engineering laboratories of the universities. We believe that the reactor hall, together with the proposed storage areas, provides adequate space for the assembly and testing of rigs for use in such a reactor.

/Demonstration

Demonstration Area. We did not feel that the provision of this was essential, but suggest that it might be combined with the proposed common room for staff and senior students.

3. e) Proposed Modifications to the Reactor

We do not believe that the restriction imposed in consideration of Wigner energy storage, and preventing continuous operation at 100 K.W., is soundly based The modifications must therefore be judged in relation to the increased flux that operation at 100 K.W. would allow particularly for beam experiments. The increase appears to us to be very marginal and sensitive to detail of flux depressions, etc. but this will not be resolved until a discrepancy between the original proposal by McLain of California and subsequent calculations has been resolved.

A more recent proposal to construct a low power assembly was considered by the Working Party. A similar assembly is the subject of a design study already in progress at the Liverpool/Manchester reactor, and we recommend that consideration of this item be deferred until a realistic cost for the assembly is established.

4. Running Costs of the Centre

The Working Party did not feel able to comment in detail on the proposals for running costs. This will presumably be a matter for the Consortium of Universities and the U.G.C. in the forthcoming quinquennium. We are concerned that the work of the centre should not be limited by inadequate running costs during the remainder of the present quinquennium, but we feel that this is a matter for negotiation between the Consortium and the S.R.C.

5. Summary and Recommendations

Arising from the Working Party's discussions there are a number of matters of general policy which require consideration by the Research Reactor Committee. These are:

(a) It appears that the policy of the Scottish Reactor Centre in providing a great deal of undergraduate teaching for University departments differs from that at the other reactor centres. We feel that this is a departure from the original concept of the Centre, and whilst it may be justified, we wish to bring it to the notice of the Research Reactor Committee. Such a policy needs some endorsement by the Committee of Principals and the U.G.C.

(b) If the policy in (a) is developed, the proposals for additional academic staff appear reasonable. We would point out, however, that such staff will make demands upon research facilities which could otherwise be made available for members of university departments.

(c) We believe that there could be advantages in siting a mass spectrometry group at the Centre, provided that the scientific case for this is agreed. We wish to comment, however, that this development, taken together with (a) and (b), could point towards the growth of a research centre having greater independence than was originally envisaged. If this is the accepted policy of the Consortium we would

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like to see it clearly stated as such to the Research Reactor Committee.

Until the above items of policy are clarified we do not feel able to make a specific recommendation concerning the proposed extension to the building. We have, however, examined the building proposals on the assumption that teaching develops along the same lines as it has done so far, and that the Centre is to embrace mass spectrometry as an additional line of research.

(d) With the above assumptions, we believe that the building proposals are reasonable, with the exception of particular items which are mentioned in 3.d) above.

On the remaining matters we are able to make the following recommendations:

(e) There is at present no conflict between items of research at the centre and the general policy laid down by Professor Mitchell's panel. With a minor exception, mentioned in 3.c) above, the same may be said of the future research programme.

(f) Further work will be required before a strong case can be made for the proposed reactor modifications. The panel did not think that Wigner energy storage would prevent satisfactory continuous operation at 100 K.W., and the increase in flux level which might be obtained as a result of the modification appeared marginal. A proposal to construct a low power assembly, which was recently added to the application, requires a design study before it can be properly assessed.

(g) Our recommendations concerning equipment are set out in the Appendix. List A would be treated as an extension of the current grant; List B would be a matter for specific S.R.C. research grants; List C would presumably be dealt with as normal "new building" equipment.

W. B. Hall (Chairman
V. S. Crocker
P. J. Grant
W. M. Loner

Secretary: G. L. Cooper (S.R.C.)

APPENDIX - Additional Equipment

LIST A. The following items are required for the present building.

	£
Auto sampler with tape punch	1,300
Two ordinary recorders	400
Six spare units for reactor control desk	3,000
Electronic spares for reactor and associated equipment	1,000
Protective clothing	200
Centre stringer isotope facility	500
Ion changer, BF_3 counters and fission chambers	410
Airnec monitors	1,000
	£7,810

The proposal to provide a link with the UNIVAC 1108 computers at N.E.L. may also fall into this category. A properly costed scheme has not yet been worked out, but it seems likely that such a link would be an economical method of providing computing facilities.

LIST B. We recommend that the following items should be the subject of individual S.R.C. research grant applications.

14 Mev Pulsed neutron generator (for neutron and reactor physics students)

14 MeV Continuous neutron generator (for neutron activation)

LIST C. The following items will be required if the proposal to extend the buildings is accepted.

	£
Second Kick sorter	3,100
Balance of scintillation and other counting equipment	1,700
Additional Na.I crystals, multiplier and plastic phosphors	1,000
One ordinary and one high speed U.V. recorder	1,100
Ekco automatic scalers	1,800
Six complete Geiger Counting assemblies	1,200
Tetronix CRO	800
Micro balance	250
Neutron monitoring equipment etc.	1,000
Extra engineering equipment	1,350
	£13,300

SCOTTISH RESEARCH REACTOR CENTRE

Application to the Department of Scientific and Industrial Research

BY
THE DIRECTOR ON BEHALF OF
THE PRINCIPALS OF THE UNIVERSITIES
OF ST. ANDREWS, GLASGOW, ABERDEEN, EDINBURGH,
STRATHCLYDE AND QUEEN'S UNIVERSITY OF BELFAST
FOR EXPANSION OF FACILITIES AT THE SCOTTISH
RESEARCH REACTOR CENTRE, EAST KILBRIDE.

January, 1965.

SCOTTISH RESEARCH REACTOR CENTRE

EXPANSION OF FACILITIES

Introduction

A grant was made available by the Department of Scientific and Industrial Research in 1962 to cover the capital and running costs of a Reactor Centre for the five Universities of Scotland and Queen's University of Belfast. The Centre was opened officially on 13th November, 1963, by Sir John Cockcroft and a report on the first year of operation was made by the Director to the Committee of Principals in July of this year. A copy of this is attached. We are very well pleased with the first year's utilisation of the Centre and the report indicates an ever increasing use of the facilities. This trend has become even more marked in the five months following the writing of the report and there has existed for some time an urgent need for extra members of staff and accommodation which will become more acute as time goes on.

To meet immediate needs three extra technicians are in process of recruitment and temporary accommodation containing three rooms totalling 1000 sq ft is presently being built on the site, the cost of which is being met by the six universities. However these actions meet only the most urgent requirements and the application which is now being made is to provide the extra accommodation, staff and equipment also required now or which we foresee will be required within the next two or three years.

Scale of Proposed Expansion

The details which follow represent, broadly speaking, a doubling up of staff, laboratory and supporting accommodation (other than the reactor hall and the reactor itself) and of scientific equipment. In support of such a scale of expansion it should be pointed out that this cannot be compared realistically to the other two University Reactor Centres set up for Manchester and Liverpool and for London, since the Scottish Centre now serves six Universities and in a greater variety of ways than do the two Centres in England.

Experience of other reactor users is that some three years or so elapse before a reactor is even half utilised. Our utilisation appears to be rising at a somewhat faster rate than this and it is clear that we must consider the probable future development of the Centre's activities with the consequent increase of accommodation, staff and equipment. It is already clear that additional space will be required in the near future. Since it averages a period of one to two years to implement any major decisions of this kind the period considered covers the next three years or so. Shortage of staff is already felt keenly in a few areas and as the Centre's work increases the need for more staff will also increase. Again certain equipment is required and more will be necessary to make full use of the existing facilities. As accommodation needs depend on staff and equipment, the last two will be considered first.

Staff

There exists a need for more lecturing and more technician staff. At present the lecturing staff have three main activities viz: running the reactor and the Centre for research projects carried out by University and other users, lectures and laboratory work connected with teaching courses and, finally, carrying out research work on their own behalf. The third of these activities is most desirable if good staff are to be recruited and retained. Meanwhile, however, it occupies very much less time than the other two duties. It was thought that pressure of work would stabilise as the Centre got under way but increasing utilisation of the facilities has had the opposite effect.

The burden of the teaching courses tends to fall, in most cases, on one particular lecturer. Whilst courses are being run an endeavour is made to keep the Centre running normally for research purposes but this reduces the assistance which could otherwise be afforded to the person running the course.

Turning to the research side we find that the utilisation of the Centre is increasing rapidly. A number of research investigations have had to be postponed, however, because the staff at the Centre could not give sufficient assistance to persons working on problems. The Centre staff have run the reactor for research workers, have helped them in the laboratory, have made equipment available and shown visitors how to use it, have given advice on the solution of many problems and so on but it is clear that in many cases, particularly on the radiochemistry and isotope sides, more active experimental association on the part of the Centre staff with the visiting staff would be most useful. For example, a person working in the medical field interested in the determination of trace elements in tissue requires chemical assistance in working out methods of separation of the elements concerned, physics assistance in working out the best way to determine these elements by counting methods and, perhaps, health physics assistance if the activities are large or live patients are involved. The time available at present does not permit anything like the amount of help which is desirable for fullest and most efficient use of the Reactor Centre. This kind of assistance is being sought very frequently and requires not only professional but also technical support.

Also as more equipment comes into use, increased electronic and mechanical support is vital. Already there is not enough.

Finally the present narrow margin of staff leaves no room for temporary absences of staff for one reason or another.

The needs of the next two or three years are therefore:—

Lecturer grade staff

One chemist with experience in radiation chemistry.

One solid state physicist.

One engineer who would take over day-to-day reactor supervision and who would also help with design of experiments.

One lecturer with experience in some aspect of biology (so many problems arise in the medical and biological fields that a physiologist, biochemist or biophysicist would be a great asset).

Estimated Annual Running Costs £9,500

Technician Staff

One Chief Technician—in charge of reactor operation and maintenance. He will act as reactor operator when one of the regular operators is absent.

Two (radiochemistry) mainly to assist in providing University service indicated above.

One (electronic).

One (mechanical) for reactor rigs and other apparatus.

It is also time to consider appointment of trainee junior technicians at the Centre when it is felt that suitable training and experience, including Day Release, could be offered.

Estimated Annual Running Costs £6,500

Equipment

We find that use of the Centre on the research side is limited more by the pulse height analyser and electronic equipment available than by the reactor itself. Thus more equipment is required to obtain maximum benefit from the Centre's facilities. We do of course expect users to bring along any pieces of specialised equipment which they may require but it is clearly unreasonable for a particular department—say medical—to buy scintillation and other specialised equipment which may be required perhaps for one month only. The extra equipment would also allow us to run larger classes allowing more time for research.

Although certain spares in the sense of components for the reactor were included with it experience has shown that it is most important to make available at an early date complete spare units, particularly electronic, which can immediately replace faulty units whilst the latter are being repaired. A good deal of time would be saved in this way.

There are also other very desirable pieces of equipment which we should like to buy because of the way in which they would extend the usefulness of the Centre.

ESTIMATED CAPITAL COSTS OF EQUIPMENT (EXCLUDING RUNNING COSTS)

	Approx. Cost
Kicksorter (*pulse height analysers*)	
Tape punch and spectrum stripper for present Laben kicksorter so that kicksorter can be used in conjunction with computer	£2,200
Two simpler kicksorters with tape punch and print out	£6,000
Electronic and Counting Gear	
Autosampler with tape punch	£500
Scintillation counting equipment (complete) 6 off	£6,000

6 spare units for reactor control desk	£3,000
6 recorders (kicksorters, thermocouples, delayed neutron and half life measurements, etc.)	£1,200
5 Ekco automatic scalers	£1,800
Electronic spares for reactor and associated equipment	£1,000
6 complete Geiger counting assemblies	£1,200
1 Tetronix C.R.O.	£800
Reactor spares and equipment	
Centre stringer isotope facility (for articles which are large, fragile or require long irradiation)	£500
14 MeV generator (pulsed, for neutron and reactor physics studies)	£3,500
Ion chamber (spare), 2 BF_3 counters, 2 fission chambers	£410
Health Physics	
Airmec Samplers (5 off)	£1,000
Neutron monitoring equipment (1 fast, 1 slow), mains charged gamma monitor (2 off), personal ionisation chambers (20 off), alpha counter	£1,000
Extra Engineering equipment	
One lathe	£500
Welding equipment	£150
Spot welder	£100
Radiochemistry	
One 14 MeV sealed off tube, continuous source (for neutron activation)	£3,500
Total about	£33,500

We wish also to modify the core of the reactor (in a method described by McLain of the University of California) by substitution of heavy water (or, possibly, beryllium oxide) for graphite. This modification which is calculated to provide an increase of neutron flux of five would also allow the reactor to be run continuously at the 100 kW level instead of being limited to a mean level of 10 kW integrated over the year as at present because of Wigner energy stored in the graphite.

Modification cost	£2,000
Cost of heavy water	£15,000
	£17,000

Accommodation

Laboratories and workshops

Radiochemistry Laboratory. The present microcurie laboratory is used both for teaching and research with the result that research is impeded whilst courses are being run. One extra room of similar area.	600 sq ft

Medical laboratory. Present biology laboratory is also used for medical studies. Rapidly increasing interest in both fields will require separate room of similar size plus small preparation room 400 sq ft + 100 sq ft. 500 sq ft

Electronics laboratory: Present one too small. One of 500 sq ft plus small tests and standards room of 100 sq ft required. Present room would be used as extension of mechanical workshop 600 sq ft

Mechanical workshop: Extra space for one more man, a lathe and storage space. Could be obtained by vacating electronics laboratory next door.

Engineering studies: No laboratory space at moment for these. Require room 600 sq ft for research and rig assembly—a high ceiling is desirable. 600 sq ft

14 MeV neutron generator room with shielded walls (for activation analysis). 400 sq ft

Demonstration room. Firms would be encouraged to display suitable equipment both permanently and (on bigger scale) for courses. This has been done already on temporary basis. 600 sq ft

Laboratory for mass spectrometry experiments (already under way). 300 sq ft

Lecture Theatre

The present lecture room (holding 35 comfortably) we find too small for certain courses and also for symposia, scientific meetings and the like. A bigger room would also be required if larger classes were run as suggested above. It would also be possible to hold two lectures at one time. A room holding about 100 persons and including a projector room would be desirable: 1,200 sq ft + 100 sq ft. 1,300 sq ft

Offices

(i) Three offices for senior attached staff, each holding 2 persons, total 600 sq ft

(ii) Large room for research students, with desks, cupboards and drawing board. 500 sq ft

(iii) Extra offices for Centre staff, total. 600 sq ft

Stores

The U.G.C. Notes on Procedure recommend storage corresponding to an area of from 15 per cent to 20 per cent of the laboratory accommodation depending on its application. Taking 15 per cent gives a permanent store of area about 1,300 sq ft to serve both old and new laboratories and workshops. 1,300 sq ft

In addition a store for radioactive rigs and other equipment removed from the reactor will be required. This should be a separate room attached to the reactor hall at a suitable place. Area about 600 sq ft

Taking into account the need for extra ancillary accommodation—lavatories, staircase and so on, a total floor area comparable to the present laboratory/office block is required.

Accommodation required:	
(Gross area including Balance, Circulation, etc.)	11,000 sq ft
Estimated cost (including Professional Fees)	£92,000
Furnishings and Equipment (excluding scientific equipment)	£8,000
	£100,000

Financing the Centre—Budgetary Expenditure

The main source of financial support of the Centre is the D.S.I.R. grant made in 1962. This has been increased to take account of increased salaries of academic and other staff and also to provide a vehicle for Centre use. However, after payment of salaries and wages, fuel, rental, insurance, heating, lighting and so on, the sum of money remaining to maintain the scientific equipment in the laboratory and to buy minor new items is only about £3,500 per annum. This is proving somewhat low and, if this figure could be increased to £8,000 per annum, it would obviate the necessity of making frequent applications to D.S.I.R. for special grants for research projects requiring only limited capital expenditure.

ESTIMATED COSTS
SUMMARY

Capital

Equipment—Pages 3 and 4	£33,500
Reactor Modification—Page 4	£17,000
New Building—Pages 5 and 6	£92,000
,, ,, —Equipment and Furnishings	£8,000
	£150,500

Running Costs per Year

(1) Staffing—Pages 2 and 3—Academic	£9,500	
Technician	£6,500	£16,000
(2) Renewal of Equipment		£4,500
(3) Travel, Subsistence, etc.		£300
		£20,800

A D D E N D U M

Estimated costs

Page 6

Running costs per year:-

Insert:

Maintenance, insurance and essential services for new building	£3,000
Revised total	£23,800

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