

# COMMISSION OF THE EUROPEAN COMMUNITIES

COM(82) 362 final

Brussels, 15 June 1982

Proposal for a  
five-year research and development programme in the field of  
applied metrology and reference materials  
Non-nuclear indirect action  
1983 - 1987

(submitted to the Council by the Commission)

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CORRIGENDUM

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PROPOSAL FOR A FIVE-YEAR  
RESEARCH AND DEVELOPMENT PROGRAMME IN THE FIELD OF  
APPLIED METROLOGY AND REFERENCE MATERIALS

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Non-nuclear indirect action  
(1983-87)

1. INTRODUCTION

1.1. AIM OF THE PROGRAMME

The aim of the programme is to reduce divergences in the results of measurements and chemical analyses in cases where:

- the disagreements are sources of barriers to the functioning of the Common Market or difficulties in its relations with non-member countries; there is a simultaneous awareness in the Member States of the inadequacy of the means of calibration and where the economic need for harmonization calls for Community action in preference to other initiatives.

Under the programme it is proposed to achieve this aim by:

- organised collaboration involving the most competent of the Member State laboratories in each project, with a view to ensuring a greater consistency of results;  
- the establishment of means of calibration resulting from this collaboration (transfer standards and reference materials), provided that they are accepted throughout the Community.

Such collaboration will permit the joint exploitation of the technical and scientific resources spread over the Community, thus ensuring greater efficiency.

The programme is scientific and technical in nature and does not involve any standardization activities. However, it serves to complement the latter by fulfilling a need which has already become apparent in certain cases and which will probably become more and more apparent in the future.

## 1.2. IMPORTANCE OF THE MEASUREMENTS TO THE COMMUNITY

Trade can only function satisfactorily if acceptable means are employed by the vendor and the purchaser to measure and weigh the products exchanged and if the trading partners are agreed on the results of their measurements. In view of the importance of the measurements, the Community has prevailed upon all the Member States to adopt officially a uniform system of units (Système International), which has become the legal standard (Directive 71/349/EEC). It has also issued a series of directives on measuring instruments. Obviously, it is not enough merely to measure and weigh the products. It is also necessary to verify their quality, and this calls for types of measurements which are much more difficult to execute than the measurement of lengths and masses. The sources of possible errors are more numerous and therefore the discrepancies between laboratories are greater. This is particularly true of chemical analyses and technological measurements.

Differences in results from one laboratory to another are a source of difficulty as far as commerce is concerned and may have considerable economic repercussions. For instance, the determination of the moisture content of cereals, which is a subject still shrouded in uncertainty, can jeopardize millions of ECU for each 1% error.

Technological progress and the quality of manufactured products with a high added value are largely dependent on high-precision measurements. This is the case, for instance, with optical and electronic instruments, and industries specializing in this area must keep in the forefront of technological progress in measurements, in order to maintain their competitive edge as regards both quality and prices. To this

and they need a substantial metrological infrastructure not only at the internal level but also on a national scale.

This type of need is not restricted to the high-technology industries.

Recently a European country had to establish a new national metrology service as a prelude to starting up its first car-manufacturing plant. In any mechanical-engineering plant it must be possible to assemble correctly the components manufactured in the various workshops. In order to achieve this aim, the components must be measured with the same degree of precision, and all measuring equipment must be calibrated correctly and frequently. When certain components are manufactured in another country, consistency of calibration must be monitored on continuous basis with the country of origin.

The Community itself is directly aware of the need for measurements and, more particularly, for measurements which are executed in all the Member States in such a way as to ensure reliable and comparable results.

The fact is that when a directive lays down quality criteria or, for example, upper limits for undesirable or dangerous substances, it is imperative that the measurements or analyses performed in pursuance of the directive are everywhere executed with the same degree of accuracy. Failing this, there is a risk that the harmonizing effects of the directive would be nullified. This is why the Member State experts are frequently prompted to refer to the BCR programme, so as to ensure the production of reference materials indispensable for the calibration of instruments and the verification of methods.

Accordingly, it can be said that the directives often call for supplementary means of calibration or verification of measuring methods. The proposed programme must therefore provide, whenever the need arises, technical and scientific support for the Community's standardization activities. Numerous projects under the current programme are directly linked to directives, in particular the directives dealing with measuring instruments, the protection of drinking water and air pollution (See also

**Annex I).**

The most thorough and most recent study on the overall economic importance of metrology, i.e., of physical measurements, is a study carried out in the United States by the National Bureau of Standards. The total cost of the measuring equipment and of the manpower assigned to operate it has been estimated at 6% of the GNP. If one were to add to this the sector involving chemical analyses, the figure arrived at would be significantly higher. Furthermore, there is every reason to believe that this estimate is also valid for the industrialized European countries.

Few estimates are available for Europe, although a number of figures do exist. Thus, in the United Kingdom expenditure on electrical measurements in industry comes to about UKL 1260 million, i.e., 3% of the turnover of the industries in question. This estimate covers only a fraction of the total measurements involved.

Likewise, in the United Kingdom, the cost of biomedical analyses comes to UKL 300 million a year, i.e., 5% of total health-care costs. In other European countries this proportion is close to 10%. The expenditure could be reduced through the development of effective systems of quality control, notably as a means of avoiding the need to repeat analyses whose results are not sufficiently reliable.

Expenditure by the public authorities and, above all, by industry to reduce pollution and monitor pollution trends has become very considerable and is reckoned in thousands of millions of ECU. In this area, many disputes are due to differences in the measured results.

The economic importance of the products and activities which give rise to trade is easier to illustrate thanks to existing statistics, e.g., those on fuels. Slight deviations in the measured results often have important economic consequences, given the considerable amounts at stake.

The economic importance of a number of products and industrial sectors covered by the proposed programme is illustrated below



by the level of intra-Community trade and by the import and export statistics.

FOREIGN TRADE

(Inside and outside the Community)

(Statistics for 1980)

Thousands of millions ECU

	Intra-Community trade	Imports from non-member countries	Exports outside the EEC
Mechanical engineering,	23.2	12.7	43.1
Automobiles	22.9	7.4	21.1
Other means of transport	3.64	5.0	6.7
Electrical and electronic engineering	13.2	11	15.1
Non-ferrous metals	7.5	9.9	5.0
Chemical products	28.5	12	26.9
Foodstuffs	27.4	24.1	13.8
Instrumentation	3.0	2.8	3.9
Coal and coal derivatives	1.8	3.2	0.5
Petroleum and petroleum derivatives	18.2	80.7	12.1
Natural gas	4.5	5.0	0.4

Source: Eurostat (1982)

In order to obtain a more comprehensive overview of the extent of the sectors, account must also be taken of total production levels.

Total industrial production levels

(Community - 1976 in millions ECU)

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Production and processing of non-ferrous metals	15 138
Chemical industry	93 930
Mechanical engineering (machinery)	76 750
"                    "          (automobile)	70 000
"                    "          (other means of transport)	24 500
Electrical and electronic engineering	70 000
Precision instruments (optical, etc.)	7 100
Food industry	138 600

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Source: Eurostat (1982)

### 1.3 BACKGROUND

The non-nuclear reference materials programme was launched in 1973 (Council Decision of 18 June 1973\*).

At the time this entailed an experimental

operation which began with a very wide-ranging survey on reference-materials needs in various branches of economic activity, and in particular in industry.

The second programme covering the period 1975-78 involved rather more substantial resources for the undertaking of reference-materials projects in a wide variety of areas, notably on an exploratory basis.

Increased resources were made available under the third programme (1979-82) for the purpose of:

- reinforcing the measures for the certification of reference materials and concentrating these measures in a number of priority areas;
- launching an applied-metrology programme;
- undertaking the distribution of reference materials, substantial stocks of which had accumulated after 1978.

Concurrently with the BCR programme, the JRC was also conducting a reference materials programme closely linked to the former. This programme involved 70 persons playing a major rôle in the management of the BCR programme in such areas as: preparation of samples, provision of secretarial services for meetings, drafting of scientific reports, performance of statistical calculations and storage and distribution of samples.

These activities ceased with the entry into force of the JRC programme which was decided on 18 March 1980 and which nevertheless made provision for the assigning of seven persons in support of indirect action (see Section 1.4).

This support, which is available mainly in the form of laboratory services, has nevertheless left a significant gap as far as the management of the current programme is concerned.

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\* OJ L 189 of 20 June 1973

## 1.4 RESULTS OF THE CURRENT PROGRAMME

### 1.4.1 Reference materials available

Work went ahead during the period 1979-82 on the detailing and finalizing of the working procedure for the certification of reference materials.

This rigorous and original procedure provides an important guarantee of the accuracy of the results.

The results of the work carried out in respect of each reference material are set out in a summary report supplied with each sample. Forty-nine reference materials were available in 1981, and in 1982 the number will exceed 80.

In 1981 five hundred samples were supplied in response to requests. The explanation for this relatively small number lies in the lack of publicity. Only a few very well informed large organizations, notably the major industrial companies, are aware of the existence of the Community's reference materials. This illustrates the need for a more vigorous publicity drive of the kind provided for in the new programme.

The revenue accruing from the supply of reference samples to outside bodies came to 34 000 ECU in 1981.

Work in the field of metrology is still in progress and only a few results can be cited as examples:

- improvement in the margin of uncertainty regarding the measurement of gas flow in gas pipelines from 0.5% to 0.2%,
- improvement in microphone calibration measurements which will lead to a correction of standards and ultimately to an improvement in noise measurements;
- Identification of appropriate means for the calibration of stations for the distribution of liquefied petroleum gas for road vehicles and identification of the principal sources of error in measurements.

#### 1.4.2 Collaboration

In order to achieve its harmonization objective, the programme provides for collaboration among Member State laboratories on each project. For the most part, the laboratories are users in their own right, i.e., industrial laboratories, official testing laboratories, laboratories which perform calibrations on demand and, in particular, national metrology laboratories. Each project culminates in a detailed discussion of the results with the aim of explaining differences and, consequently, finding means of remedying them. Such collaboration is highly fruitful. Numerous participants consider, for their part, that the operations organized in this way by the Community are extremely useful.

Collaboration also takes place at ACPM level, particularly as regards the certification of reference materials. Each Member State has the opportunity to verify that the work has been executed properly and sufficiently meticulously, before the results are certified.

This collaboration which, in the case of each project, brings together the best laboratories in the Member States has the effect of increasing the efficiency of the potential already available in the Community. The benefits, even for those Member States possessing the best laboratories, lie in the economic field and result in a reduction in barriers to trade and a lower incidence of disputes in the application of the rules and in national and Community trade and in trade with non-Member countries.

#### 1.4.3 Assessment

The programme has correctly fulfilled its rôle in providing an incentive to collaboration. This is borne out by the swift launching of the metrology programme and the fruitful participation of the principal laboratories in the Member States. In the field of reference materials all participants are of the opinion that the collaboration which exists and which is being intensified is an essential element for progress.

The group of independent experts which carried out the assessment of the BCR programme (1975-78)\* expressed satisfaction with the way the projects had been selected and carried through. The users which it consulted by questionnaire also came out very much in favour of the programme.

The group recommended the continuation of the programme with an eye to the Community's sectoral policies and proposed a number of operational simplifications and clarifications. The recommendations, notably those concerning certification procedures, have been put into effect immediately. The certification procedure, in particular, was adopted in collaboration with the ACPM.

\* Assessment by the Community Bureau of References (EUR 7422).

## 2. DEFINITION OF THE NEW PROGRAMME

### 2.1. Type of work

Most of the studies covered by this programme will take the form of intercomparisons with the participation of laboratories in most, if not all, of the Member States. The effect of these studies will be to improve agreement of results and measuring methods, and to produce transfer standards and reference materials which will enable all the user laboratories to achieve calibration in relation to well-defined points of reference.

The programme will also help to improve measuring methods and techniques where the economic implications of deficiencies justify a special outlay. Collaboration will make it possible both to take advantage of all the scientific potential available in the Member States and to guarantee a consistent development of the methods by those principally concerned in each country.

The subjects listed in the description of the programme have been selected after a wide-ranging consultation of experts from the Member States. The fact that they have recommended such a large number of topics reflects the importance the Member States attach to this programme. It also explains why the new programme is more extensive than the last. The topics the Commission has selected for the programme from among these suggestions are those which have more immediate economic implications.

(See also 1.2.)

The programme is concerned with physical measurements (generally covered by the term "metrology") and chemical analyses. The same approach is required, in all cases, to achieve exact measurements.

Compared with the previous programme, the amount of attention devoted to protection of the environment has been increased considerably as a result of numerous requests from industry

and inspection bodies. Similarly, in the field of health protection the programme includes a chapter on foodstuffs which did not figure in the old programme.

2.2. The programme in relation to general policy

The technical content of the programme reflects the priority options of the research strategy, as set out in Document COM (81) 574.

In its specific measures, the programme's contribution as regards the general objectives is as follows:

- |                              |   |
|------------------------------|---|
| Industrial competitiveness   | Product quality                         |
|                              | Technical barriers                      |
|                              | Interaction of industry and environment |
| Agricultural competitiveness | Fertilizers, soils                      |
|                              | Product quality                         |
| Energy                       | Fossil fuels                            |
|                              | Energy-saving                           |
| Raw materials                | Non-ferrous materials                   |
| Quality of life              | Protection of the environment           |
|                              | Health protection                       |

The need to improve measurements in the Member States is apparent in practically all the fields covered by Community policies: the common market and technical barriers, environment, energy and agriculture policies. A priori there is no reason to exclude some fields rather than others - hence the variety of topics. A direct relationship with Community activities is particularly obvious in areas covered by directives (see Annex 1).

The programme thus corresponds to the objectives of the industrial strategy and those of the energy strategy as defined in documents COM (81) 620 and COM (81) 540, respectively.



### 2.3. Measurements in industry and technical barriers

Industry is faced with the problem of measurements:

- in its purchases of raw materials and equipment for which it must be able to check quality,
- in its production processes,

Mechanical, electrical and electronics construction industry requires an increasingly high level of metrology. Heavy industry requires measurements of pressure and of temperature, and chemical analyses (standardization of automatic analyses)

- in selling its products,

It is essential for the Community's economy that the quality of industrial products cannot be disputed by buyers (in the Community or elsewhere) on the grounds of inaccurate measurements.

This type of dispute is not only sometimes very costly, but may also weaken the position of European producers on world markets. Excellent quality backed up by indisputable measurements is undoubtedly a great asset in terms of competition;

- in applying regulations relating to protection of the environment and of workers' health:

Constraints imposed by the need to protect the environment and the health of workers and the general public are now very exacting and sometimes involve considerable financial outlay on the part of industries. When it comes to difficult chemical analyses, there can be a very considerable range of discrepancies between the various laboratories. Most industrialists feel the need for reference materials certified for analyses relating to the environment so that they have some protection against devastatingly expensive disputes.

The proposed studies in this field are described in the following paragraphs.

The examples given in each paragraph are merely simplified illustrations.

### Geometrical and mechanical metrology

The importance of measurements in this field has already been emphasized in the introduction (1.2) where attention is drawn to the fact that a European country has had to set up a national metrology service in order to meet the requirements of a motor vehicles factory which would not otherwise have been able to operate satisfactorily.

The development of the Common Market makes for greater industrial integration with the effect that units produced in one country can be assembled in another Member State. An essential prerequisite is that measurement must be precisely consistent in the countries concerned.

With regard to the quality of measurements in industry, this description will be confined to one particular case. The improved performance of motor vehicle engines (reduced running-in time, for instance) is a result of increased precision in the manufacturing process. Modern measuring equipment which makes it possible to measure length to within a few micrometres in three dimensions, is now indispensable if the quality of complex units is to be guaranteed. Moreover, two European motor vehicles manufacturers produce and sell such measuring machines themselves. There are, however, no adequate means of verification and calibration. Industrial requirements are therefore beyond the actual possibilities of calibration.

It is important to respond to this state of affairs by making a joint effort at European level to reach agreement as to the means and methods of verification, to avoid creating technical barriers and to increase the quality of European machines for the export market.

This is merely an example to illustrate the importance and usefulness of studies dealing with the following subjects:

- improvement of the measurements of dimension and of surface conditions needed for mechanical construction in general and for the construction of measuring apparatus, instruments and machines;
- improvement of the accuracy of the measurements of very small

lengths (of about one micrometre or less) for the electronics industry and its equipment;

- improvement of the sensors needed for automation, and of the means of calibrating them; there are virtually no means of calibrating them other than static means whereas these sensors, which transform a variation in pressure, strain, displacement etc into an electrical signal, basically operate dynamically.
- improvement of measurements of force and pressure.

#### Electrical metrology

Electrical measurements are now required everywhere. A wide variety of equipment is produced in the Community. Although the equipment is checked and calibrated in the country of origin, it still has to be used in other countries. This means that measuring systems must be exactly equivalent in all the Member States. It is planned to carry out studies with a view to filling existing gaps, thereby helping not only to ensure that the quality of measurements is satisfactory everywhere, but also to stimulate an improvement in quality. The fact that quality will thus be assured will inevitably mean fewer barriers to trade in this type of equipment. It should be noted, incidentally, that certain measurements come under specific legislation. This is the case, for example, in the monitoring of the power of ultrasonic equipment (used increasingly in medicine), which involves a measurement which is as yet very uncertain.

#### Studies planned:

- improvement of equivalence between scales of measurement of the principal electrical quantities: current, voltage, power, capacity, inductance, in direct or alternating current;
- improvement of transfer standards for multiples and sub-divisions,
- improvement of measurements of electrical quantities at very high frequencies (required for telecommunication) and improved synchronisation of time measurement throughout the Community;
- improvement of measurements of electromagnetic interference;
- improvement of measurements of the power of ultrasound (for medical applications).

### Optical metrology

The need for agreement at European level applies to optical, as it does to electrical measurements.

Although there are several very large lighting equipment companies in Europe, measurement of luminous flux may vary from one country to another by over 20%.

No progress has been made either in the measurement of radiation emitted from the lasers used increasingly in technology and medicine. Studies should mainly cover the following:

- the measurement of luminous flux emitted by various types of discharge tubes used for public lighting applications,
- measurement of the characteristics of luminaires,
- measurement of the power of laser radiation,
- measurement of UV radiation (industrial applications, health protection),
- agreement between the scales of spectral radiance from the infra-red to the ultra-violet region,
- measurements on optical fibres,
- the sensitivity of infra-red detectors.

### Temperature measurements

The reasons for improving the equivalence of all the other types of measurements referred to above apply equally well to measurements of temperature. In this case, however, there are certain special features, such as the fact that temperature-measuring equipment is not very stable and therefore requires frequent recalibration, especially at high temperatures.

Automation of processes, for example in the steel industry, has created the need for a degree of accuracy which it is impossible to attain with any certainty.

Not all the Member States are equipped to make calibration of this type. Users apply sometimes to one country and sometimes to another with a consequent difference in results which is evidently incompatible with practical necessities.

Studies will on the whole be concerned with measurements of high temperatures.

- improvement of measurements of high and low temperatures and of equivalence of results from the various national laboratories;
- improvement in the stability of thermometers and thermocouples;
- improvement of the means of standardization and of transfer standards intended to guarantee equivalence of results from different laboratories.

#### Chemical analysis of metals and other raw materials

Reference materials for the steel industry are produced by national bodies which consult one another in the context of the Commission's legislative activities. Insofar as these bodies will want to pursue their own certification activities independently of the BCR programme, the latter will be concerned, above all, with non-ferrous metals. The programme will, nevertheless, undertake to certification of reference materials, at the request of the steel industry, for problems whose difficulty is beyond national means.

The non-ferrous metals industry has established a long tradition of collaboration with the BCR programme. It will be necessary to make provision to undertake to produce, if requested, the most difficult reference materials, in particular for zinc and copper (a very low or medium-level concentration of impurities).

For example, the European copper industry is supplied with very pure cathodes by non-member states. Prices depend on the impurities present in the metal. The level of concentration is so low in this case (1-2 ppm) that results vary considerably from one laboratory to another. Reference materials are therefore necessary, but the only way to achieve them is to use the resources of all the most competent laboratories in Europe.

One of the reference raw materials certified by the BCR, zirconium (for its oxygen content) is now running out. European

users and producers of fuel for nuclear reactors currently need a more fully certified metal (impurities and alloy elements) in order to avoid too many disputes as to the qualities of metal available on the world market.

With regard to the other raw materials (with the exception of fertilizers dealt with under the heading of agriculture and energy sources) there has been no clear identification of the requirements involved. Nevertheless, provision must be made for the programme to extend to other problems concerning important raw materials, which cannot as yet be foreseen.

#### Physical and technological properties of materials

Most bulk industrial products are in powder form, and the behaviour of these powders during handling, transport and subsequent treatment depends on properties such as grain size, surface properties, and sintering or casting capacity. A wide variety of measurements are taken, but methods and results are confused and lead to numerous problems in the industry and to frequent trading disputes. The previous programme covered projects which proved useful. Reference materials are required for the most varied of industries in Europe and elsewhere.

Comparisons of measurements of material properties, such as hardness or impact strength, have produced highly varied results, and this problem must be solved at Community level, especially if we are to keep pace with developments in this area in the United States.

Below are just two examples which only illustrate part of the work planned.

- Establishment of reference materials for the calibration of optical and electrical properties and thermal conductivity (the latter being covered in the section on Energy).
- Establishment and certification of reference materials for the properties of materials in powder form (grain size, surface properties, sintering).
- Technological properties  
Improvement in the means of controlling and calibrating mate-

rials-testing machines: hardness, mechanical strength, impact strength, fatigue strength. Work will involve intercomparison campaigns and the establishment of reference materials.

#### 2.4. Measurements in the energy sector

Transactions in natural gas and petroleum products need accurate determination of quantities. This determination, which requires measurements of flow rate and volume, is, in turn, subject to sources of errors which are not sufficiently controlled. A first contribution from the Community programme has been to reduce the differences between national laboratories by 0.5 to 0.3% for measurements of national gas flow rates in gas pipelines. Differences of this kind, over millions of cubic metres, obviously represent considerable amounts. Work should continue at different levels for measurements of natural gas flow rates.

The work will involve:

- improvement in the measurements of gas and petroleum product flow rates (Directives 71/318/EEC and 71/319/EEC);
- improvement in measurements of hot water flow rates (Directive 79/820/EEC).

In addition to flow rate measurements, energy product markets stipulate numerous quality specifications: the calorific value of gas and coal, waste and pollutants in coal, etc.

Reference materials are required to improve analyses and to determine the properties of natural gases and for the analyses and the determination of properties of coal.

Finally, the programme will continue work on measurements on insulating materials (energy-saving).

2.5. Measurements in environmental protection and nuisance prevention

Measurement problems in this area take on a trade and industrial dimension which is backed up by numerous laws and the sensitivity and awareness of the general public and the authorities. In this instance, variations between the laboratories as regards the results of pollutant analyses (such as traces of heavy metals, lead, cadmium, mercury, etc.) are not several percent, but often several 100%, if not a factor of 10. Nonetheless, it is in this context that major investment must be made to alter manufacturing processes and make them less polluting. Depending on the point of view or the sign of the errors, the industry would be subjected to constraints that are too exacting or the consumer and the population to dangers that are excessive.

Given the more than European dimension of the problem of pollution, it is important that the quality of measurements be improved. The demand for new reference materials by the industry and control bodies is great.

In the area of trace analysis, work in progress since several years will result in 1982 in the certification of some reference materials for the environment. This programme will allow increasingly difficult projects to be undertaken in the environmental sector. However, organic reference materials has been set back by problems of preparation and conditioning.

In contrast, the programme in the dangerous organic compounds sector has already produced (with the aid of the JRC Petten) a series of pure carcinogenic compounds available in the form of certified materials. These are required extensively by the inspection laboratories of drinking water, oil companies and the automotive industry.

Another particular case concerns the analyses required to apply the Directives on the exhaust gases from cars, which require reference gases which must be standardized at European level. This internal need is accompanied by another confronting the manufacturers of automobiles for export to the United States.



They must comply with American regulations which lay down that measurements must be in conformity with American standards. There is a real advantage in establishing European references for gas analyses which could then be linked up with American references. Collaboration in this respect is possible and would bring about a market improvement in the situation.

The projects in the programme will involve the certification of reference materials in three areas:

1. Pollution due to heavy metals

Determination of dangerous heavy metals (lead, cadmium, mercury, chromium)

- in matter consumed by humans (water, milk, meat, fish, vegetables)
- in polluting vectors (water, air, dust, soil)
- in pollution sources (industrial waste, sludges from waste water treatment and used as fertilizer, coal, etc.)

2. Pollution due to organic compounds

- reference materials for the determination of carcinogenic compounds in water, dust and foodstuffs;
- reference materials for the determination of other dangerous organic compounds, such as pesticides, dioxins, PCB, etc.

3. Air pollution due to other gases

- reference gases for analyses of CO, CO<sub>2</sub>, C<sub>3</sub>H<sub>8</sub> (produced primarily by automobile exhaust - Directive in preparation);
- reference gases for SO<sub>2</sub> pollution (Directive of 30.8.1980) and NO<sub>2</sub> pollution (Directive in preparation).

Other nuisances

a. Noise

Noise measurements are still the subject of much dispute. Even for the simplest measurements under well specified conditions the main laboratories still obtain varying results.

The basic studies have been undertaken in the current programme and should be continued in the next with progressive inclusion of more complex situations closer to practical conditions.

b. Electromagnetic radiation

Electromagnetic radiation interferes with measuring instruments, electronic apparatus in general, and telecommunications.

In addition, certain domestic (microwave ovens) and industrial generators expose users directly to a real, but as yet, hardly known danger (Draft Directive COM(80) 340).

Laboratory measurements must be checked and improved.

2.6. Health protection

Foodstuffs

The problems encountered at Community level with regard to foodstuffs are similar to those outlined in respect of the environment. Without going into heavy metals or carcinogenic products for a second time, reference is made to the more specific case of hormones in meat. Analysis methods are not fully developed, results are highly variable and have given rise to major disputes, often accompanied by serious economic consequences.

The foodstuffs sector is a new subject in the programme, the topics put forward being the result of contacts on numerous counts with inspection laboratories in the Member States and with the industry.

Work should cover:

- the determination of important compounds in the evaluation of the nutritive value of foodstuffs (milk, oil, fat, cereal-based products);
- the determination of non-desirable products (hormones in meat) and products subject to controls (colouring agents); dangerous elements such as heavy metals in meat and fish, etc. are covered under the section on the Environment;

- the determination of dangerous compounds, carcinogens and fermentation toxins (mycotoxins and especially aflatoxin).

Biomedical analyses and occupational medicine

Several Member States have developed national systems to control the quality of analyses in the biomedical sector. In addition, some suppliers of reagents also organize analysis campaigns. The values obtained by laboratories, thought to be particularly expert in this field, are used as reference values.

There is a lack in this sector of established or certified reference materials to provide a link between the national systems and to ensure that accurate values are adopted everywhere. The projects will be geared to some of the more pressing needs of clinical chemistry and haematology.

There are also plans to work in conjunction with the WHO on the preparation of reference materials linked to WHO standards, which are currently accessible to only one laboratory per country. This involves products defined by their biological and/or biochemical activity and not by the mass or concentration of a compound. Substances to be covered in the relatively near future include immunoglobulins and the pituitary thyroid stimulating hormone (TSH).

The problem to be solved from the outset of the programme in occupational medicine will be the preparation for certification of reference materials for lead and cadmium determination in the blood (Directive 77/312/EEC). Analysis of other metals in the blood and urine, such as chromium and nickel, will also be considered. Studies should then be geared to poisoning indicators for organic substances such as phenols.

## 2.7. Measurements in agriculture

It is proposed that studies be limited to subjects where there is a pressing need.

### 1. Fertilizers

Since Directive 76/11/EEC provides for the use of reference materials, studies in this area should be designed to cover a sufficiently large range of products.

### 2. Cereals

The considerable economic impact of humidity on cereals has already been mentioned in the introduction. This is a problem which appears straightforward, but which is nonetheless very difficult to solve. Studies in this sector have been touched upon in the current programme, which should be continued and brought to a close in the 1983-87 programme.

3. The problems of pollution caused by heavy metals (especially soil) are covered in Section 2.4, with the exception of fertilizers.

4. A certain reserve should also be kept in hand for any new requirements that might crop up during the period covered by the programme.

## 2.8. Working method

The projects originate as suggestions or problems submitted to the Commission by users such as industrial or inspection laboratories. Some projects begin as requests from Commission departments working on technical barriers or the environment, for example.

Each topic proposed is the subject of a survey among potential users and experts in the Community, aimed at determining what is the measuring problem that is raised, whether it has any economic importance, whether it concerns more than one Member State and whether any work is likely to arrive at a solution.

If the prospects are favourable, the project is drawn up and then submitted for opinion to the ACPM. As in the case of each research programme, the Commission is assisted by an Advisory Committee on Programme Management. The Commission will continue to draw the attention of the Member States to the importance of ensuring that users are sufficiently represented on this Committee.

Each project is open to participation by laboratories in the Member States that wish to take part.

Expenditure involved in the preparation, packaging and storage of reference materials is to be borne by the Community.

Preliminary inter-comparison work carried out as an exercise is unpaid.

Measurements and analyses carried out during the final stage are reimbursed at 50%.

#### 2.9. Relationship with national and international activities

The programme is obviously not intended to replace existing national and international activities.

In the case of physical measurements, i.e., the field of metrology proper, the majority of the Member States have a national metrology service and a network of calibration laboratories that are coordinated by the former. This set-up ensures that the measuring system is coherent with regard to the users, in particular industry. The national metrology services collaborate with each other within the International Committee of Weights and Measures with regard to basic units and certain derived units, i.e., in a fairly limited field of measurement that leaves a vast area of less basic metrology uncovered.

Since the calibration laboratories in each country are coordinated by a national department, the metrology projects must in the first instance concern the laboratories that are responsible for coordination at national level, these being the primary laboratories or sometimes university or industrial laboratories.

As regards chemical and technological measurements or analyses, there is no structured hierarchy, and the choice of the most

highly-qualified laboratory in each Member State is not pre-determined.

The programme is not intended to take responsibility for reference materials that could very well be produced at national level or be left to private initiative. Neither is the object therefore to duplicate materials already available in Europe or elsewhere.

The establishment of reliable measuring techniques based on firm European cooperation will make it possible to undertake comparisons with major non-member countries where economic interests are at stake (technical barriers, for example).

The programme having demonstrated its effectiveness, the United States National Bureau of Standards is expressing the wish to intensify contacts and to cooperate in certain specific projects, such as gas analysis. Likewise, exploratory talks should determine to what extent similar cooperation with Japanese bodies can be envisaged. In both cases, cooperation will be sought in particular in those areas where it could help to remove technical barriers to trade.

#### 2.10. Cooperation with the JRC

The JRC programme for the period 1980-83 provides support for the BCR programme on reference materials amounting to 7 man/years. This comprises a scientific and technical contribution to certain projects (analyses and consolidated reports) and logistic support in the preparation of samples.

Such support is provided by the Geel, Ispra and Petten Establishments, in keeping with their specific skills.

Consideration is being given to ways and means of ensuring better coordination and integration of the activities of the CBNM relating to nuclear reference materials with those conducted by the BCR in the non-nuclear field.

In the context of the reorganization of the JRC programme, it is proposed to make the CBNM the laboratory for the preparation, packaging and storage of certain non-nuclear reference materials that require a special environment during such operations.

The activities of the CBNM in the field of nuclear reference materials and those of the BCR relating to non-nuclear reference materials will gradually be more closely connected and the Geel Establishment will be the preferred instrument for this increased coordination.

### 3. RESOURCES REQUIRED

#### 3.1. Justification

The economic importance of measurements has been abundantly illustrated in the introduction, in particular by their cost, which is estimated at more than 6% of GNP in the United States.

Their importance for the Community is bound to be similar. The volume and the value of the goods concerned can be illustrated by the value of industrial production in the sectors concerned by the programme (more than 500 000 million ECU) and the volume of the Community market, estimated at 150 000 million ECU in 1980 (see also Section 1.2).

The Community Member States have a central metrology institute with an annual budget of approximately 35 - 40 million ECU, to which are added the many calibration laboratories coordinated at national level. The other Community Member States have more decentralized structures of equivalent or lesser importance. In the United States, the National Bureau of Standards (NBS), the central body responsible for metrology, has an annual budget of approximately 105 million dollars of which 7.5 million dollars are devoted to reference materials.

The activity of the NBS in the field of reference materials constitutes the largest known national programme. Activities in Europe are much more modest.

On the other hand, the NBS establishes its reference materials on the basis of its own work, and its programme does not include a harmonization component, as does the Community programme. This component, which is essential for the benefit derived by the Member States, makes it necessary for a large number of laboratories to take part and represents the bulk of the cost of the programme in terms of contracts.

Cooperation and concerted action is organized at meetings that are numerous in view of the necessarily large number of projects and whose cost represents the bulk of the administrative costs of the programme.

For an initial period of 15 months, the reference materials sector of the current (1979-82) programme received support from the JRC's non-nuclear METRE programme, which occupied a staff of 70. In addition to laboratory work, the JRC provided considerable assistance to the BCR programme in drafting reports of meetings, organizing the work of the laboratories taking part, conducting uniformity studies, drafting reports consolidating the results and carrying out statistical calculations.

In pursuance of the Council Decision of 18 March 1980 on the JRC programme, the METRE programme was deleted and the support reduced to 7 man/years, mainly in the form of laboratory work.

A considerable effort has been made in order to overcome this situation, in particular by calling on outside experts.

This solution is not satisfactory, since qualified specialists in the Member States have generally little time to devote to the BCR, and there follow delays in the management and execution of the work.

Lastly, the lack of staff resulting from the modification of the JRC programme has not made it possible to devote sufficient effort to the dissemination of results, which explains the small number of samples that have been requested. In the new programme, special attention will be devoted to the dissemination of results. In particular it is intended to:

- publish specialized articles in the technical literature; and
- distribute advertising brochures at specialized meetings or conferences, so as to provide a direct stimulus to the awareness of specialists from the laboratories concerned.

These tasks will devolve upon the staff requested for the execution of the programme.

The increase in staff requested is proportionately lower than the increase in the budget, the latter being largely due to the fact that the programme would have to concentrate on pro-



jects of increasing difficulty and greater importance for the Community.

FINANCIAL RESOURCES FOR THE CONTRACTS AND EQUIPMENT PURCHASES

<u>Industry and trade</u>	<u>Million ECU</u>	
Mechanical metrology	2	
Electrical metrology	2	
Optical metrology	2	
Temperature measurement	1	
Physical and technological properties of materials	1.5	
Analysis of metals (and possibly other raw materials)	1.5	
		10
<u>Energy</u>		
Flowrate measurements	1.5	
Properties and analyses of natural gases and coals	1.7	
Energy saving	0.5	
		3.7
<u>Protection of the environment</u>		
Analyses of trace amounts of heavy metals	2	
Analysis of carcinogenic or toxic organic compounds	2	
Gas analysis	2	
Noise and electromagnetic radiation	0.7	
		6.7
<u>Health protection</u>		
Foodstuffs	2.3	
Biomedical analyses and occupational medicine	1.0	
		3.3
<u>Agriculture</u>		
Fertilizers	0.3	
Measurements concerning agricultural products	0.5	
		0.8
Total	24.5	

STAFF

<u>A &amp; B grade staff</u>	
Mechanical metrology	}
Flowrate measurements	
Electrical metrology	}
Electromagnetic radiation	
Temperature	}
Optics	
Physical and technological properties	1A
Analyses of metals	1A
Natural gases and coals	}
Gases (for the environment)	
Trace amounts of heavy metals (environment)	1A
Toxic and dangerous organic compounds	1A
Foodstuffs	1A
Biomedical analyses	}
Occupational medicine	
Statistical calculations	1A
Financial and administrative management	}
Dissemination of reference materials	
Head of Division	1A
<u>Secretariat</u>	6C
 Total:	 13A + 1B + 6C

BUDGET FOR FIVE YEARS

Staff	7.200.000
Administrative expenditure and costs of meetings	3.000.000
Contracts, equipment purchases and pre- paration of materials	24.500.000
	<hr/>
	34.700.000 ECU

ANNEX ICOMMUNITY DIRECTIVES IN FORCE OR IN PREPARATIONTHAT PROVIDE THE BASIS FOR WORK IN THE CURRENTPROGRAMME

- Lead glass (69/493/EEC)
- Cosmetics (76/768/EEC)
- Sulphur content of gas oils (75/716/EEC)
- Drinking water (79/869/EEC and 80/778/EEC)
- Lead and cadmium in the blood (77/312/EEC)
- SO<sub>2</sub> in the air (80/779/EEC)
- NO<sub>2</sub> in the air (in preparation)
- Calibration of apparatus for measuring motor vehicle exhaust gases (in preparation)
- Lead and cadmium in meat (in preparation)
- Fertilizers (76/11/EEC)
- Classification, packaging and labelling of dangerous substances (sixth amendment to 67/548/EEC)
- Gas volume meters (71/318/EEC)
- Cold-water meters (75/33/EEC)
- Meters for liquids other than water (71/319/EEC)
- Hot-water meters (79/830/EEC)
- Measuring instruments (71/316/EEC)
- Health protection against the dangers of microwave radiation (COM(80) 340)
- Radio interference produced by motor vehicles (72/245/EEC)
- Liquefied petroleum gas measuring systems fitted to vehicles (in preparation)
- Noise protection at the work place (in preparation)

ANNEXOPINION OF ACPM

The ACPM-BCR studied at its meeting the proposal for a Community Research and Development Programme in the field of Applied Metrology and Reference Materials for the years 1983-1987. It has examined this proposal in the light of the current and previous programmes.

The ACPM wishes to draw the attention of the Commission and of the Council to the importance of accurate measurements in trade, industry, health services and science. Quality control of industrial and agricultural produce, the easing of trade barriers caused by disagreement on measurements, improvements in health (assessment), protection of the environment and the proper application of Community directives is in most cases possible only if accurate measurements are carried out by industrial, health and government laboratories in the Member States. The BCR programme is orientated towards providing solutions of many problems still existing in this field. This is done by collaborative measurements in both reference materials and applied metrology. An important aspect of the Programme is to resolve disparities between countries which often have very serious economic consequences.

This has been achieved in the past BCR Programmes for both reference materials and metrology. Collaboration has developed in an excellent atmosphere and has been fruitful.

The BCR Programme, in supporting financially the collaboration of many laboratories for the benefit of each Member Country, is to be considered essentially complementary to national programmes and is justified in terms of Community objectives.

In order to best respond to real and changing needs of the Community, especially in the implementation of Community policies (e.g. directives), a reasonable measure of flexibility must be retained in the operation of the Programme. It would be appropriate to review the Programme after three years, in the light of the above considerations.

.../...

The ACPM judges the new programme proposals adequate to meet the challenges of the next five years, based on the collaboration of laboratories and institutes in the Member States, including those of the JRC for its specific contribution. The proposed resources are acceptable in principle in view of the particularly heavy tasks in the broad but important field of reference materials and applied metrology, whose applications cover almost all fields of measurements.

DRAFT  
COUNCIL DECISION

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adopting a research and development programme  
for the European Economic Community in the field of  
applied metrology and reference materials  
(Community Bureau of Reference - BCR)

(1983 to 1987)

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THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 235 thereof,

Having regard to the proposal from the Commission,

Having regard to the Opinion of the European Parliament (1),

Having regard to the Opinion of the Economic and Social Committee (2),

Whereas Article 2 of the Treaty assigns to the Community the task of promoting, throughout its territory, a harmonious development of economic activities, a continuous balanced expansion and an accelerated raising of the standard of living ; whereas the objectives of the Community's activities for these purposes are set out in Article 3 of the Treaty ; and whereas, more specifically, paragraphs (a) and (h) of Article 3 state that the activities of the Community shall include the elimination, as between Member States, of quantitative restrictions on the import and export of goods, and of all other measures having equivalent effect, together with the approximation of the laws of the Member States to the extent required for the proper functioning of the Common market ;

(1) OJ N°

(2) OJ N°

Whereas the activities provided for by this Decision appear to be necessary in order to achieve these objectives ;

Whereas the discrepancies between the results of measurements in different countries give rise to difficulties in commercial transactions ;

Whereas research projects covered by this Decision are intended to reduce some of the discrepancies and improve the quality of measurements throughout the Community and will, as a result, help the competitiveness of Community products, on both the internal and the external market ;

Whereas the Treaty makes no provision for the specific powers required to act for these purposes ;

Whereas in its Resolution of 14 January 1974 on a first action programme of the European Communities in the field of science and technology (3), the Council emphasized that the whole range of available ways and means, including indirect action, should be used in an appropriate manner ;

Whereas the Scientific and Technical Research Committee (CREST) has delivered an Opinion on the Commission proposal,

HAS DECIDED AS FOLLOWS :

#### Article 1

A research and development programme for the European Economic Community in the field of applied metrology and reference materials, as defined in the Annex, is hereby adopted for a period of five years with effect from 1st January 1983.

#### Article 2

The necessary funds for the total duration of the programme are estimated at 34.7 million ECU and the staff required at 20.

(3) OJ N° C7, 29.1.1974, p.6



The European monetary unit is defined in the Financial Regulation in force.  
These figures have only indicative value.

#### Article 3

The Commission shall be responsible for the implementation of the programme. It shall be assisted in this task by the Advisory Committee on Programme Management set up by the Council Resolution of 19 November 1973, the terms of reference of which are set out in the Council Resolution of 18 July 1977 (4) on advisory committees.

#### Article 4

During the third year the programme shall be reviewed and where necessary, revised in accordance with the appropriate procedure and after consultation of the Advisory Committee on Programme Management.

#### Article 5

The information resulting from the implementation of the programme shall be disseminated in accordance with Council Regulation (EEC) N°2380/74 of 17 September 1974 adopting provisions for the dissemination of information relating to research programmes for the European Economic Community (5).

Done at Brussels,

For the Council,  
The President,

(4) OJ N° C 192, 11.8.1977, p. 1

(5) OJ N° L 255, 20.9.1974, p.1

A N N E XApplied Metrology and Reference Materials  
Community Bureau of Reference

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The objective of the programme is to improve the agreement of measurement and analysis results in fields which are of economic importance to the Community and of relevance to the objectives of the Treaty. The projects will also result in establishing calibration means (transfer standards and reference materials) to ensure that consistency, once achieved can be maintained. The work could also lead to the definition of methods whereby accurate measurements can be obtained.

The programme includes two closely related parts :

Applied metrology

This part covers measurements of physical quantities and physical properties traceable to fundamental quantities.

The activities will include :

- execution of measurement programmes on a cooperative basis (intercomparisons)
- improvement of the methods of measurement and of their accuracy ;
- improvement of the instruments necessary for accurate measurements, and in particular of transfer standards.

Reference materials

This part of the programme concerns chemical analyses as well as physical and technological measurements which could result in establishing reference materials.

The activities will include :

- execution of measurement programmes on a cooperative basis (intercomparisons)
- establishment of reference materials on a cooperative basis and the certification of these materials at Community level ;
- conservation and dissemination of the reference materials established as a result of the programme.

Experimental work will be carried out under contract.

FINANCIAL STATEMENT1. Budget heading : 73731.1. Title of the programme ; Applied metrology and reference materials2. Legal basis :

Article 235 of the EEC Treaty

Council Decision of

3. Definition of the programmeObjectives

- to improve the quality of measurements and results in the Community by stimulating cooperation between laboratories in the Member States ;
- to improve measuring methods,
- to establish means of calibration (transfer standards and reference materials).

Description

The individual projects will be chosen on the basis of the economic importance of the subject from a Community point of view. Each project will be implemented on a cooperative basis by laboratories in several Member States. The experimental work will be carried out under shared-cost contracts.

4. Justification of the programme

When, in trade, the laboratory of a buyer and that of a vendor do not agree on the results of measurements, the disputes may have serious economic consequences. Similarly, the application of national and Community regulations can give rise to serious problems if the laboratories concerned do not agree.

The programme will contribute to improving agreement between the results in fields which are of importance to the Community from an economic viewpoint.

### 5. Financial implications

#### 5.1. Total cost

#### 5.2. Proportion financed by

- the budget of the Communities	34.700.000 ECU
- the national budgets	
- other sectors at national level	7.000.000 ECU

#### 5.3. Multiannual schedule

#### Appropriations for commitment in millions of ECU

	1983	1984	1985	1986	1987	Total
Staff	1.2	1.3	1.42	1.56	1.72	7.20
Administration	0.5	0.54	0.6	0.64	0.72	3.00
Contracts	4	4.7	5.5	6.5	3.8	24.5
	<u>5.70</u>	<u>6.54</u>	<u>7.52</u>	<u>8.70</u>	<u>6.24</u>	<u>34.70</u>

Appropriations for payment in millions of ECU

	1983	1984	1985	1986	1987	1988	Total
Staff	1.2	1.3	1.42	1.56	1.72	-	7.20
Administration	0.5	0.54	0.6	0.64	0.72	-	3.00
Contracts	2.0	4.1	4.4	5.0	5.40	3.5	24.5
	3.7	5.94	6.42	7.20	7.84	3.5	34.70

5.4 Method of calculationa) Staff expenditure

Staff expenditure is assessed on the basis of :

- 13 category A officials
- 1 category B official
- 6 category C officials.

It is calculated by taking the average costs adopted for each category in the 1981 budget and applying an annual increase of 10% to take account of adjustments made necessary by inflation.

b) Recurring administrative and technical operating expenditure

This was assessed on the basis of the preceding programme and mainly covers expenses for meetings and missions.

c) Expenditure under contracts

This expenditure covers :

- the work on measurements and analyses carried out under shared-cost contracts;
- the work necessary for the preparation of reference materials and samples

.../...

The expenditure on measurements and analyses was assessed on the basis of the level of expenditure in the 1979-1982 programme with a net increase of 10% per year, taking into account a probable inflation rate of 10% per year.

6. Financial implications regarding staff and administrative expenditure :

see point 5.4

7. Financing of expenditure :

Appropriations to be entered in the 1983 to 1988 budgets.

8. Revenue

A modest revenue may be anticipated, deriving from services to undertakings or public or private bodies on request and against payment. Such services mainly involve the delivery of samples with calibration certificates.

It is not possible to estimate what the upward or downward variations of such income will be over the next few years.

The revenue will be shown in Chapter 6.2., Article 623, of the General Budget (Statement of Revenue). It may be used to cover additional expenditure for which provision is made under Item 7392 of the Statement of Expenditure.

9. Controls

a) Financial controls carried out by the departments of DG XII and by the DG for Financial Control with regard to the regularity of the expenditure and the implementation of the budget.

b) Scientific controls : competent officials of DG XII and the ACPM.