

Annex 2: Testing/Inspection Organization



1 Institutes under Industrial Research and Development Agency (BPPI), MOI

1.1 Institute for Research and Development of Material and Technical Product Industries(Balai Besar Penelitian dan Pengembangan Industri Bahan dan Barang Teknik)(IRDMTP/B4T)

1.1.1 General profiles

B4T's history dates back to 1909 when it was established in Batavia as a metal testing laboratory. It moved to its present location in 1961 and came under BPPI in 1980 with its present name.

B4T consists of 5 departments, Material Research, Product Technology Research, Material Development, Product Technology Development, and Administration. It is staffed by 195 persons, of which 124 persons (63%) belong to R&D divisions. 13 (10%) belong to research divisions and 104 (84%) development divisions. There are 4 assessors, 13 inspectors, and 6 calibrators. Chart A2-1 shows B4T's organizational chart.

1.1.2 Services and activities

(1) Testing and inspection service

B4T conducts a wide range of material tests including analyses of cement, concrete, building materials, organic and inorganic materials, metal, and water related to chemistry, corrosion, and environmental pollution, and provide testing and inspection services for a variety of products including metals and metallic products, machinery, automotive parts, rubber and rubber products, plastics. B4T conducted 17,288 tests in 1991, 17,841 in 1992, and 18,661 in 1993.

(2) Calibration service

B4T is a member of National Calibration Network and provides calibration services for production equipment of private enterprises in terms of force, pressure, temperature, mass, and volume. The results of calibration are recorded in a calibration report (see Appendix A2-1) conducted stating the date of calibration, the name of a calibrator, type of calibration, equipment calibrated, standards used, and their traceability. Upon completion of calibration, a certification label is affixed to equipment. 585 calibrations were conducted in 1991, 648 in 1992, and 650 in 1993.

(3) Quality system certification

B4T conducted quality system certification tests for manufacturers of pressure vessels, heat exchangers, boilers, and storage tanks. 13 tests were conducted in 1991, 5 in 1992, and 4 in 1993.

(4) Product certification

Product certification covers plant equipment including pressure vessels, heat exchangers, boilers, and storage tanks. B4T conducted 43 product certification tests in 1991, 49 in 1992, and 60 in 1993.

(5) Technical inspection service

This service is roughly divided into technical inspection and failure analysis. The former covers construction of sugar refining, petrochemical, power, and fertilizer plants, and petroleum and natural gas industries. Between 1991 and 1993, B4T conducted 4 inspection services annually. Failure analysis involving checking piping damage in plant equipment including superheaters, coil heaters, coolers, condensers, drilling, heat exchangers, and compressors. 5 projects were conducted in 1991, 7 in 1992, and 7 in 1993.

(6) Training service

B4T offers training courses for inspections in the fields of welding, boiler, quality assurance, corrosion, and basic engineering. It conducts around 20 workshop and short-term training courses including the training of engineers related to inspection of concrete structures, welding technology, non-destructive testing techniques, ultrasonic testing, and testing and calibration technologies, as well as training courses for management, project managers, and ISO 9000 series. Major activities in the field of training service conducted by B4T are shown in Chart A2-2.

1.1.3 Revenues

B4T's major revenue sources are the government's routine budget, the development budget, and technical service fees. Previously, it has been funded solely by the government budget. Then, it was authorized to perform testing and inspection service under a presidential decree during which it expanded payment for services aggressively. As a result, its revenues from technical service grew rapidly since 1991 and accounted for 63% of the total revenue under its budget in 1993. Now, with the government's instruction,

for an anticipated decline in revenue from the government budget.

In FY1993, B4T's total revenue amounted to Rp. 3,171,590,000 (150 million yen). It grew 2.5 times over the past five years, while revenues from the government routine budget increased 1.6 times, those from the development budget 4.6 times, and those from technical service 3.1 times. Nevertheless, the revenues do not fully cover expenditures, together with a large percentage of labor cost (75%) B4T is virtually prohibited from the upgrading of its facilities, and purchasing and renewing its testing equipment. B4T's budget and revenue trends during the past five years are shown in Chart A2-3.

1.1.4 Facility and equipment

The facility has total floor area of 13,230m², of which laboratories account for 10,016m² (76%). B4T recognizes the shortage of laboratory space and is considering facility expansion by adding a new floor above the existing laboratory building. Buildings are 11 - 32 years old after completion. Although partially deteriorated, they are fairly well maintained and interior space is tidied up and cleaned. On the other hand, air-conditioners are installed in only small portions of the facility, and ventilation and lighting are not sufficient. In particular, this becomes a problem as special laboratories, such as a thermostatic chamber, a clean room, and a shield room, which require precise testing conditions, are not air-conditioned, excepting a dark room for an incandescent lamp testing, nonetheless B4T recognizes the need. Also, some laboratories are fully packed with testing equipment and leave little working space. Clearly, testing environment is not sufficient and needing various improvements.

The facility has a variety of testing equipment, most of which is outdated. Some are unserviceable due to aging. For instance, non-destructive testing equipment including X-ray, ultrasonic testing, magnetic particle testing, and crack depth measurement were all purchased between 1975 and 1982. Destructive testing equipment includes a large horizontal tensile testing machine (300 tons), universal testing machines of varying size, Charpy impact tester, and hardness tester. Calibration and daily maintenance of these equipment seem to be sufficient. However, all of them were purchased between 1912 and 1979. In particular, most of the universal testing machines are of old type. Material testing equipment such as universal testing machines, impact testers, and hardness testers are not subject to abrupt changes in mechanism and measurement method, so that old equipment can produce reliable results as it is well maintained and calibrated. Nevertheless, rapidly advancing industrial technology demands quick availability of accurate measurement results, which requires latest testing and inspection equipment that can meet these needs. Metallographic testing equipment and corrosion testing equipment,

such as microscopes, salt spray testing equipment, and gas corrosion testing equipment, were purchased in 1970 - 1973. Chemical analysis of metallic materials is conducted by flame photometer, spectrophotometer, emission-spectrometer, infrared spectrometer, and gas chromatography, all of which were purchased between 1972 and 1982. Electrical testing equipment are relatively new among B4T's testing equipment which include power factor meters, high voltage meters, and discharge testers, all were procured between 1977 and 1980. Testing equipment related to cement includes soil tester, mortar compression testing machine, mortar bending testing machine, and fluidity testing apparatus, and their procurement years vary between 1930 and 1980. Concrete testing equipment including crushing strength testing machine, specific gravity hydrometer, compression testing machine, bending testing machine, abrasion testing machine, and workability test apparatus were purchased between 1930 and 1980. In summary, B4T has a variety of testing equipment capable of performing a wide field of tests, which are well maintained. However, these equipment are 10 - 60 years old and cannot meet high level testing and inspection requirements of latest standards. Thus, they should be upgraded to latest ones if B4T is to meet industrial needs. Given a large stock of equipment at B4T, it is very difficult to replace or upgrade existing equipment within a short period of time. Instead, it is important to establish long-term plans for upgrading and adding of equipment that should be selected according to the importance and frequency of use.

B4T already have plans to upgrade or reinforce analytical equipment and universal testing machines including atomic absorption flame emission spectrophotometer, emission-spectrometer, and apparatus for rapid determination of carbon and sulfur in iron and steel, and metal and cement testing equipment including semi-automatic Charpy tester, microhardness tester, and metallographical microscope. To materialize these plans, however, appropriate financial and technical backups are essential. Testing equipment currently owned by B4T is summarized in Chart A2-4.

1.1.5 Other

In order to assure reliability of testing and inspection results, B4T takes the following measures: (1) its testing division adopts ISO Guide 25 and is now preparing for certification, (2) the inspection division is operated in accordance with ISO Guide 39 and is preparing for certification, and (3) certification of products, human resources, and quality systems are done on the basis of ISO Guide 40, and the certification process is underway.

B4T conducts its tests and inspections according to a variety of standards, namely, SNI,

B4T conducts its tests and inspections according to a variety of standards, namely, SNI, JIS, ASTM, ASME, AS, BS, AWS, API, and DIN. SNI is primarily used for testing and inspection related to buildings, metal, mechanical engineering, chemical engineering, and automobile engineering, while JIS covers ferrous and non-ferrous, concrete, plastics, machine elements, welding, and metal. ASTM is used in the fields of iron and steel products, non-ferrous metal products, chemical analysis, petroleum products, lubricant oil, coating, plastics, rubber, water quality, and environmental engineering. AS and BS are used for calibration, and AWS and API for piping and welding.

Since most testing equipment have deteriorated due to aging, it is very difficult, if not impossible, to replace or upgrade all of them within a short period of time. Instead, long-term equipment upgrading and strengthening plans should be established to improve testing capability by selecting equipment according to importance and frequency of use. At present, B4T plans to upgrade or reinforce analytical equipment and universal testing machines including atomic absorption flame emission spectrophotometers, emission-spectrometers, and apparatus for rapid determination of carbon and sulfur in iron and steel, and metal and cement testing equipment including semi-automatic Charpy testers, microhardness testers, and moist cabinets.

For the development of researchers, B4T sends 27 persons to domestic or foreign research institutes during the four year period between 1991 and 1994 in an attempt to improve technical levels. By area of specialization, 7 trainees belong to metrology and calibration, 5 material testing, 5 chemical analysis, 4 quality control, 2 electrical component inspection, 2 management systems, 1 thermal treatment, and 1 cement, reflecting B4T's efforts to develop specialists in a broad range.

1.2 Institute for Research and Development of Metal and Machinery Industries (Balai Besar Penelitian dan Pengembangan Industri Logam dan Mesin) (IRDMMI/BBLM)

1.2.1 General profiles

BBLM was established in Bandung as Metal Industrial Development Center (MIDC) under Circular 57 of the Director General for Basic Industry. In 1970, MIDC received equipment supply and technical assistance from Belgium. In 1980, it was reorganized to become an organization under BPPI and obtained its present name. Today BBLM consists of 4 divisions, namely Process and Product Technology Research, Process Technology Development, Product Technology Development, and General Service, and is staffed by

220 persons, of which 124 (56%) belong to research and development divisions. Of total, 8 staff (6%) are responsible for research, and 116 (94%) are engaged in development projects. Within the development division, 79 persons (68%) are working on process technology development. BBLM has one assessor. Its organizational chart is shown in Chart A2-5.

1.2.2 Services and activities

(1) Process and product technology development service

BBLM is engaged in development of process technologies including casting, machinery, welding, metalworking, thermal treatment, and plating, and the development of product-related technologies, including analysis, evaluation, and design of products, commercialization technology, and management. It also conducts joint research projects with private enterprises concerning materials and production jigs and tools, and provides process and product technology development services.

(2) Testing service

BBLM renders a wide range of testing service including destructive testing of materials involving tensile, bending, or compression, nondestructive testing using ultrasonic waves, mechanical running tests, and tool shape tests. In 1993, it conducted 10 tests.

(3) Calibration service

BBLM is a member of National Calibration Network and provide calibration services for production equipment of private enterprises in six categories, namely length, force, pressure, hardness, shape, and torque. The results of calibration are recorded in a calibration report (see Appendix A2-2) conducted stating the date of calibration, the name of a calibrator, type of calibration, equipment calibrated, standards used, and their traceability. Upon completion of calibration, a certification label is affixed to equipment. Calibration contracts increased rapidly from 65 in 1991 to 150 in 1992 and 439 in 1993. BBLM maintains traceability of its own calibration equipment by KIM-LIPI.

(4) Training service

BBLM offers training courses in a variety of fields including material strength testing, material selection techniques, nondestructive testing techniques, and product evaluation and design technologies.

While each training shop has some new equipment. Most equipment are old type

a high frequency induction furnace and a graphite spheroidizing tester for production of ductile cast iron products, and Furan resin binded sand molding equipment.

1.2.3 Budget

BBLM's revenues come from two sources, those earmarked in the government's routine and development budgets and those from technical service. Total revenue in FY 1993 amounted to Rp. 1,695,349,000 (80 million yen), of which revenues from the government budget accounted for 59% and technical service fees a remaining 41%. Revenues from technical service increase rapidly over the past four years between 1991 and 1994. Compared to 1991, those in 1992 grew 1.8 times, 1.9 times in 1993, and 2.5 times in 1994 (a 6-month period) reflecting BBLM's efforts in increasing its own revenues from technical service. It should be noted, however, that revenues from testing, inspection and calibration services account for a very small portion of the total (the highest percentage, 1.7% in FY1993) and the bulk of revenues come from technical research service. To increase revenues from testing, inspection, calibration and training services, BBLM is preparing pamphlets on these services to pursue active sales to private enterprises. As a result, service contracts are gradually on the rise. Nevertheless, its revenues are not large enough to finance facility improvement, and procurement and upgrading of testing equipment, and thus virtually remain intact. BBLM's budget and revenue trends during the past five years are shown in Chart A2-6.

1.2.4 Facility and equipment

BBLM's facility has total floor area of 9,220m², of which laboratories and testing areas occupy 5,620m² (61%). The facility was completed in 1973. Despite more than 20 years after completion, laboratories and other rooms are well maintained. Experiment fields used for research and development, testing, and training related to casting, forging, welding, and other operations, however, are large in size and produce large amounts of heat, vibration, noise, dust, and exhaust gas, which go beyond the capacity of the existing ventilation system. Together with poor lighting, these factors make the facilities less suitable for reliable testing. Furthermore, some laboratories are not air-conditioned and do not have sufficient working space, suggesting the need for improvement.

Existing equipment was supplied by the Belgian government, most of which were installed in 1975 and 1976. The major purpose of BBLM is to improve product quality and productivity in metalworking and machinery industries. It has a casting shop, a metalworking shop, a welding and sheet metal working shop, and a heat treatment/plating shop, each of which has a training shop and related testing rooms. Major equipment of

shop, each of which has a training shop and related testing rooms. Major equipment of each shop are summarized as follows.

Casting shop: cast iron and non-ferrous metal melting furnaces, thermometers, and CE meters for melting operations; green sand molding machine, core molding machine, and sand mixer for molding operations; shot blasting machines and grinders for after-treatment; and various woodworking machines for model making.

Metalworking shop: lathes, grinding machines, boring machines, electric spark machines, cutter grinding machines of various types, and dimension and shape measuring instruments.

Welding and sheet metal working shop: including oxygen/acetylene gas cutters, welding machines, plasma-arc cutting machines, electrical welding machines, TIG/MIG welding machines, spot welding machines, stud welding machines, bending machines, and cutters.

Heat treatment/plating shop: heat treatment furnaces, salt baths, plating tanks, and shot blasting machines.

Testing equipment for metallic materials includes universal testing machines, impact testers, and hardness testers for destructive testing, and X-ray equipment, magnetic inspection equipment, ultrasonic flow detector, and metallographical microscopes for nondestructive testing. Testing equipment required for inspection of casting sand is also provided. Between 1991 and 1994, BBLM purchased coating thickness gauges, rotary bending fatigue testing equipment, hardness testers, ultrasonic thickness gauges, micrometers, surface roughness testers, lathes, dynamic distortion amplifiers, and distortion gauge foils. Despite such efforts to increase testing equipment, new equipment accounts for a very small portion and most equipment is nearly 20 years old and has become obsolete. Clearly, it is difficult for the existing equipment to achieve testing and inspection levels required by latest standards, and the upgrading and strengthening of equipment stock to meet latest needs is called for, including internal stress measuring instruments. Also, analytical equipment checking chemical components of metallic materials seems to be in shortage. Emission spectrometers and other instruments are needed to analyze chemical components quickly and accurately. BBLM's existing equipment are listed in Chart A2-7.

1.2.5 Other

BBLM owns training shops for casting, metalworking, welding/sheet metal working, and heat treatment/plating, which are used to provide training for employees of private enterprises. Also, joint research and development projects as well as production contracts with private companies have developed strong ties with the private sector and contributes greatly to the fostering and development of metalworking and machinery industries in Indonesia. For instance, in the field of casting, BBLM has manufactured a prototype crank case for horizontal one-cylinder diesel engines which is produced by a diesel engine manufacturer as a pilot project. Also, it receives many requests for calibration from private enterprises, covering measuring instruments for length, force, pressure, hardness, shape, and torque.

BBLM adopts testing and inspection methods from a variety of standards including SNI, JIS, ISO, and ASTM, and calibration methods based on JIS, ISO, DIN and other standards. It plans to improve technical levels in the areas of destructive and nondestructive tests, equipment operation, vibration, electricity, metallurgy, sand, and chemical composition, and to reinforce related equipment. As for calibration, it intends to improve measurement techniques related to length, force, pressure, temperature, and mass, and procure related equipment.

For training of in-house researchers, BBLM sent 32 persons to domestic or foreign research institutes over 5 years between 1990 and 1994 in an attempt to raise technical levels of the institute and its service. Breakdown by area of specialization indicates that trainees in the metrology and calibration field account for a majority (15 persons), followed by 5 in vibration, 4 in quality control, 4 in management system, 2 in nondestructive testing, 1 related to assessor, and 1 in design. This reflects BBLM's emphasis on metrology and calibration fields.

1.3 Institute for Research and Development of Ceramic Industry (Balai Besar Penelitian dan Pengembangan Industri Keramik) (IRDCRI/BBK)

1.3.1 General profiles

BBK was established as Ceramics Research Institute in 1922 and acquired its present name in 1980.

It has 7 departments and 202 employees, consisting of : Director General (1),

Administration Department (63), Ceramics Research Department (21), Fine Ceramics Research Department (25), Ceramics Development Department (37), Fine Ceramics Development Department (36), Maintenance Service Department (12), and Documentation and Information Department (7).

The organizational chart is shown in Chart A2-8.

1.3.2 Activities and services

Major activities of the departments are summarized as follows.

- (1) Administration
General administration and service within the institute
- (2) Ceramics research
Research and study on general and special ceramics, and mortar.
- (3) Fine ceramics research
Fine ceramics, glass, and enamel
- (4) Ceramics development
Research and study on economics, engineering, standardization of tests, and certification related to general and special ceramics and the ceramic industry
- (5) Fine ceramics development
Development activity related to items in (4) for the fine ceramic industry
- (6) Maintenance service
Maintenance of research facilities including utilities, and construction of experimental facilities
- (7) Documentation and information
Procurement of relevant documents, literature and information, and dissemination of R&D results

Testing and inspection items conducted by BBK, its staffing and the number of testing and inspection services provided during the past 5 years are shown in Chart A2-9.

As seen in Chart A2-9, BBK received 635 requests for testing service in 1993, of

which tests related to materials account for the largest portion (379 cases, 60%). It also reviews applications for SNI certification.

1.3.3 Budget

BBK's budgets for the five year period are shown in Chart A2-10, and revenues from testing and calibration service in Chart A2-11.

The budget doubled during the period from around Rp. 700 million to Rp. 1,400 million. During the same period, revenues from testing and calibration service increased more than fivefold from Rp. 8 million to Rp. 44 million, which are not large enough to cover budget deficits.

The amount of the 1993/94 budget (Rp. 1.4 billion) per research staff (200 persons) is Rp. 7 million (approximately 350,000 yen), which is far below financial requirements for facility improvement, and the procurement and upgrading of testing equipment.

1.3.4 Facility and equipment

BBK has total floor area of 8,538m², of which laboratory area accounts for 727m². The list of existing equipment is shown in Chart A2-12. The present condition of major equipment is described as follows.

(1) Chemical analysis

BBK owns a variety of equipment for chemical analysis including AAS, a flame photometer, a X-ray fluorescence spectrometer, which are calibrated every month. Nevertheless, most of them are relatively old having been procured between 1974 and 1992. All the balances, the most basic weighing scale for chemical analysis, are of direct-reading type, and BBK has no electronic balance. Also, the balances are kept in chemical analysis rooms where precision equipment may be eroded by acid vapor affecting precision levels, so that they should be isolated from such corrosive environment by separating measurement rooms from those for analysis. In particular, chemical analysis rooms are not equipped with fans in draft chambers, allowing acid vapor to flow into the room in the evaporation and exsiccation process. There are other problems that are not unthinkable in modern chemical analysis. This indicates the need not only for upgrading analytical equipment, but also retraining of analytical engineers or the hiring of qualified experts.

Analysis of chemical components of raw materials is conducted by the gravimetric method by burning them with gas in a platinum crucible. However, gas burning results

in poor accuracy levels of analysis, as the number of platinum crucibles is limited to hinder efficient analysis. On the other hand, PT. Sucofindo has many crucibles and use an electrical furnace for burning, achieving high levels of accuracy and efficient analysis. While the X-ray fluorescence spectrometer is capable of performing quantitative determination of raw chemical components quickly and in large quantities, the model owned by BBK was manufactured in 1980 and is not currently used. Since chemical analysis of raw materials accounts for the largest portion of requests made to BBK, it is important to procure the latest model of X-ray fluorescence spectrometer or obtain additional crucibles and a high performance electric furnace.

(2) Micro-structure test

BBK owns a X-ray diffractometer, a SEM, and an IR spectrometer, which were procured in 1978, 1982, and 1983, respectively. Among them, the X-ray diffractometer is essential in analyzing crystal structure of ceramic raw materials, but the existing equipment is rarely used. The C-ray diffract chart shows poor resolution making it difficult to conduct crystal analysis with high accuracy, so a new X-ray diffractometer should be procured urgently.

(3) Thermal analysis

BBK has a large number of equipment related to thermal analysis, including DTA/TGA. However, DTA is more than 20 years old (purchased in 1973) and other equipment are generally old.

(4) Optical test

A wide variety of optical testing equipment including microscopes is available. These equipment can be used as long as they are well maintained.

(5) Mechanical test

BBK has 5 models of strength testers, of which 2 are currently unserviceable.

(6) Physical test

Physical testing is required for testing final products including ceramic building materials. BBK has 23 types of physical testing equipment, accounting for the largest percentage of existing equipment stock. However, the abrasion tester and the Vicat hardness tester are unserviceable. Since these equipment are not owned by private companies, quick repair and replacement are recommended.

Note that the above equipment listed in (1) through (5) are all foreign made, e.g., Japan and Germany, and are not well maintained. Since it is difficult to obtain spare parts for foreign-made equipment, reliable standards for daily inspection and maintenance need to be established and followed faithfully in field. Then, as new equipment is obtained in future, consideration should be given to structure and environment of the room accommodating the equipment, together with training of engineers and technicians who will use it.

1.3.5 Other

(1) Standards and testing methods

BBK adopts SNI standards, and if applicable, follow internationally accepted standards that specify testing methods, including EN, IEC, ASTM, DIN, JIS, and ISO. Nevertheless, it does not always cover all the test items. To ensure expansion of exports in future, the country is required to establish uniform standards for testing methods that cover items not included in the present testing (for instance, freeze resistance, adhesiveness, and slipperiness tests) and should then be enforced to industries. (Note that this effort does not require costly equipment.)

(2) ISO 9000 certification organization

BBK plans to become an accredited ISO 9000 certified organization by May, 1995 and is currently training assessors and lead assessors. Once it obtains such accreditation, the institute will be able to show a stronger leadership to the ceramics industry.

(3) ISO Guide-25

BBK is considering compliance with ISO Guide-25.

(4) Staff training

BBK's staff training consists of the following:

- 1) In-house training
- 2) Training by outside organizations such as PUSTAN, JICA, and LIPI

(5) Strengthening measures

BBK has requested outside organizations for assistance related to the strengthening of its capabilities and resources, although what efforts are being taken, and how they progress are not known.

1.3.6 Other government and private testing and research institutes related to testing of ceramic building materials

As described below, other government organizations conduct similar testing and research services related to ceramic building materials.

(1) B4T's concrete testing

B4T conducts various tests for cement and concrete (which are rarely done by BBK).

Major test items are as follows.

- 1) SNI tests: Chemical analysis of cement, mortar strength test, and concrete strength test
- 2) Tests based on foreign standards: Including JIS, DIN, and ASTM

(2) LIPI

In Serpong, there are many research institutes under LIPI, among which Mineral Research Institute and Environmental Management Center have latest facilities and equipment. In fact, these facilities offer geographical advantage to companies located in the suburbs of Jakarta over BBK in Bandung, explaining why many companies ask LIPI's institutes for chemical analysis.

(3) PLN-LMK

It conducts tests for insulators.

(4) RIHS

Research Institute for Human settlement (Pusat Penelitian dan Pengembangan Pemukiman) is a building material testing center under the Ministry of Public Works (PJU), situated in Bandung. It has modern equipment and conducts research and study specifications for ceramic materials as well as tests for improving strength of bricks and tiles from the user's standpoint and interest. It seldom conducts testing and inspection on tiles that is chiefly performed by BBK.

(5) PT. Sucofindo

The company has laboratories in many locations throughout the country, that have a wealth of equipment. In particular, many companies far from Bandung request Sucofindo for testing service, particularly chemical analysis, due to convenience and quick availability of data.

(6) Other building material testing centers within the city of Jakarta

In addition, there are many building material testing facilities within the city, as shown in Chart A2-13. While companies located in the suburbs of Jakarta use them for testing and inspection service, their existence is not well known among new comers who do not use them frequently. To encourage the use of these facilities, efforts are needed to let them known to the public, including various advertisement activities under the leadership of ASAKI.

1.4 Institute for Research and Development of Chemical Industries (Balai Besar Penelitian Dan Pengembangan Industri Kimia)(IRDCI/BBIK)

1.4.1 General profiles

BBIK was established as a research center in 1938. It was later renamed to Industrial Research Institute and then to its present name in 1980.

It has 5 departments, namely Petrochemical and Fertilizer Research and Development, Fermentation and Organic Chemistry Research and Development, and Administration. Its primary objectives are improvement and proliferation of technology related to chemical industries, the development of human resources, preparation and propagation of SNI standards. To accomplish these objectives, it conducts research and development in the fields of packaging technology, fertilizer testing, composition of insecticide, pollution control, plastic processing, fermentation technology, perfume and dye production technologies, metallic material testing technology, and calibration technology.

The organizational chart is shown in Chart A2-14.

1.4.2 Services and activities

(1) Product technology development service

BBIK's product technology development service is led by joint R&D projects with private enterprises in the areas of production of insecticide and fertilizer from local raw materials, fermentation, perfume and dye production, food packing materials and technologies.

(2) Testing service

BBIK's testing services include the analyses of fertilizers, industrial gases, plastics, packing materials, fermented products, food and beverage, exhaust gas, and waste water, and testing of metallic materials. The latter has been conducted under BBLM's technical

assistance since 1993 and 12 tests were conducted in that year.

(3) Calibration service

As seen in the testing of metallic materials, BBIK has been providing calibration service for testing equipment of private enterprises since 1993 in the areas of length and pressure. The results of calibration are recorded in a calibration report (see Appendix A2-3) by stating the date of calibration, the name of a calibrator, type of calibration conducted, equipment calibrated, standards used, and their traceability. Upon completion of calibration, a certification label is affixed to equipment. In 1993, 16 calibration contracts were performed. BBIK maintains traceability of its own calibration equipment by BBLM.

1.4.3 Facility and equipment

BBIK's facility has total floor area of 13,032m², of which 8,928m² (68%) are occupied by laboratories and testing areas. Of total, laboratories for metallic material testing and calibration account for 437m², occupying a large area compared to a relatively small number of equipment. Each laboratory is well maintained, tidied up, and cleaned. However, ventilation, air-conditioning, and laboratory tables are less than satisfactory.

As for testing equipment, analytical equipment for raw materials and products includes flame photometers, ultra-violet/visible spectrophotometers, infrared spectrophotometers, gas chromatography, Karl Fisher moisture meters, and atomic absorption spectrometers, which were all purchased between 1983 and 1986. For research and development of insecticide, fertilizer, fermentation, and polymeric materials, infrared spectrophotometers, microscopes, softness testers, impact testers, hardness testers, colony counters, polarimeters, viscometers, refractometers, calorimeters, color meters, plastic cutting instruments, which were purchased between 1975 and 1985. For testing of metallic materials, universal testing machines, ultrasonic testing machines, hardness testers, impact testers, tensile testing machines, and surface roughness testers were relatively newly purchased between 1991 and 1992. Calibration equipment includes micrometers, gauge blocks, vernier calipers, and pressure gauges which were purchased in 1992. Thus, testing, inspection and calibration equipment are relatively new, but not sufficient in quantity. Also, the existing equipment is not capable of performing measurement in new areas of technology. Testing equipment currently owned by BBIK are listed in Chart A2-15.

1.4.4 Other

BBIK has been devoting its efforts and resources to research and development in the

fields of organic chemistry and environmental chemistry. In particular, it has been introducing new testing equipment and measurement technology in the field of environmental chemistry since 1993 under JICA's assistance. In the next few years, it is expected to become a critical research center in the field.

As for testing and inspection services, in 1993, BBIK started destructive and nondestructive tests on metallic materials and calibration services for length and pressure under technical assistance of BBLM. Although its 1993 revenues from these services amounted to Rp. 1 million only, BBIK plans to expand its service base in the future.

An organization within BBIK currently providing testing and calibration services belongs to Environmental Group and is staffed by 3 persons qualified in metrology and 2 in calibration service (See Appendix A2-4). It emphasizes proper management of measurement methods and results by preparing testing manuals and work sheets (Appendixes A2-5 and A2-6). Testing and calibration methods are based on JIS, ASTM, BS, ISO, NBN, DIN, AS, and ASME.

BBIK plans to add testing equipment such as X-ray equipment, heat treatment equipment, and load cells, and calibration equipment including laser beam measuring instruments and gauge block calibrators.

It is making vigorous efforts to develop in-house research staff and sent 9 persons to domestic or foreign research institutes during the past five years between 1990 and 1994. Of total, metrology and calibration specialists account for a majority (6 persons), followed by quality control (2), and nondestructive testing (1), clearly focusing on metrology and calibration.

2 Other Government and Public Organizations

2.1 The Centre for Testing and Quality Control (Pusat Pengujian Mutu Barang) (CTQC/PPMB)

2.1.1 General profiles

PPMB is a technical service organization established by the Ministry of Trade in 1979 for the purpose of promoting the improvement and maintenance of quality of Indonesia's non-oil export products. It operates 20 local laboratories (LPMs) and more than 400 sampling organizations responsible for export inspection (BPCs), that are located throughout the country, and accredits and supervises private enterprises who are authorized to inspect and certify their own products. Also, PPMB forms a network system with LPMs, BPCs, and the accredited private enterprises to maintain quality control of export products.

PPMB consists of 5 laboratories, namely Standards, Physics and Chemistry, Microbiology, Mechanical, and Electrical, and 2 administration departments, Technical and General. The organizational chart is shown in Chart A2-16.

2.1.2 Services and activities

(1) Technical development service

PPMB is responsible for certification of domestic services by LPMs, BPCs, and accredited private enterprises, research and development of new testing and analytical methods, the updating and revision of standards, the improvement of product quality of the accredited companies, provision of technical information, guidance, and assistance required for the improvement of testing and inspection techniques, and supervision of product evaluation and testing management by member organizations.

(2) Testing service

Since export inspection needs to be completed within a relatively short period of time due to shipment and departure schedules, actual inspection service is conducted by the network member organizations. Export inspection mainly covers agricultural products such as rubber, pepper, vegetable oil, and coffee beans, while it only covers three types of industrial products, namely electrical cables and wires, batteries, and incandescent lamps. Instead of direct product inspection, PPMB provides a variety of testing services required to maintain the accuracy levels of testing and inspection by the member organizations, including cross-checking tests such as round-robin and parallel

tests, and proficiency tests.

(3) Calibration service

PPMB is a member of National Calibration Network and provides calibration services for testing equipment of the network member organizations in three categories, namely length, mass, and temperature. The results of calibration are recorded in a calibration report (see Appendix A2-7) that specifies the date of calibration, the name of a calibrator, type of calibration, the name of a person requested calibration, equipment calibrated, and standards used, and calibration certificates are issued. BBLM maintains traceability of its own calibration equipment by DOM and KIM-LIPI.

(4) Training service

PPMB is conducting training service to disseminate new testing services, standards, and techniques to the network member organizations.

2.1.3 Equipment

PPMB's facility consists of four laboratory buildings where testing and inspection on agricultural products are conducted, a laboratory building for testing of product quality, and a main administrative building. Testing equipment is divided into chemical analyzers for raw materials and products, and testing and inspection equipment. The former includes ultraviolet/visible spectrophotometers, gas chromatography, liquid chromatography, and atomic absorption analyzers. The latter includes various distillation test apparatus, autoclaves, washability apparatuses, and firing/ignition testers. Overall, testing and inspection equipment for agricultural products is sufficient in quantity and variety. The existing equipment has been supplied under assistance of OPNRI (U.K.) and CERLAB (France).

2.1.4 Other

Laboratories of the network member organizations are located throughout the country, in Lhok Seumawe, Medan, Padang, Jambi, Pekanbaru, Pangkal Pinang, Bengkulu, Palembang, Tanjung Karang, Jakarta, Bogor, Semarang, Surakarta, Jember, Surabaya, Singaraja, Pontianak, Banjar Baru, Palangkaraya, Samarinda, Ujung Pandang, Manado, Ambon, and Ternate. These laboratories are considered to be primary candidates for testing and inspection of industrial products. PPMB has been accredited as a rubber testing organization by International Rubber Association (IRA). It is also a member of ILAC (International Laboratory Accreditation Committee), IOS, and IFEAT (International

Federation of Essential Oils and Aroma Trades). PPMB's certificates on coffee, cocoa, perfume, and tea are accepted in the U.S. and the U.K.

2.2 Center for Development of Agricultural Engineering (Balai Besar Pengembangan Alat dan Mesin Pertanian (BBP Alsintan)

2.2.1 General profiles

BBP Alsintan was launched in 1987 as the ATA-220 project of Director General of Food crops, the Ministry of Agriculture, implemented under technical assistance of JICA, in order to conduct research and development of agricultural machines and implement it if found suitable for use in Indonesia. In 1991, it became under the supervision of the Agency for Agricultural Research and Development (Bandang Penelitian dan Pengembangan Pertanian departmen Pertanian) (AARD), under the Ministry of Agriculture, in the present organization and name.

As of December 1994, BBP has 4 divisions under direct supervision of Director General, namely, Administrative Division, Development Planning Division, Technical Assistance and Support Division, and Functional Group. It is staffed by 116 employees in total, of which 81 belong to the three technical divisions, 12 in Development Planning, 18 in Technical Assistance and Support, and 51 in Functional Group. By educational level, 81 persons in the technical divisions are divided into 11 with Master's degree, 39 with Bachelor's degree, 27 senior high school graduates, 2 diploma holders, and 2 division managers, The organizational chart is shown in Chart A2-17.

2.2.2 Services and activities

Major activities of the three technical divisions are summarized as follows:

- (1) Development planning division
 - 1) To study the progress of the agricultural mechanization process and analyze the result for the purpose of developing agricultural machines and implements suitable for local conditions peculiar to Indonesia;
 - 2) To provide policy makers with information useful for policy making in the field of agricultural mechanization in Indonesia;
 - 3) To make recommendations and provide guidance for evaluation of the development of agricultural machines and implements;
- (2) Technical assistance and support division
 - 1) Accumulation of technological resources and management of facilities and

equipment

- 2) To conduct joint research and demonstration projects on agricultural machinery
- (3) Functional group
 - 1) Design of agricultural machinery and prototype development
 - 2) To conduct testing and evaluation services for standardization, approval and regulation of agricultural machinery

BBP Alsintan conducted 8 and 19 performance tests on agricultural machinery in 1993 and 1994, respectively. Details of these tests are summarized in Chart A2-18.

2.2.3 Budget

The center is operated under funding from the government budget and World Bank. Operation funds have been growing steadily during the past 4 years, as shown below. Note that labor and testing costs are not included in these budgets.

(Unit: million Rp.)

	National Budget	World Bank	Total
1991/1992	100	-	100
1992/1993	250	112	362
1993/1994	725	66	791
1994/1995	1,350	63	1,413

Inspection service fees are assessed and charged on an actual cost basis.

2.2.4 Equipment

The facility is located within a 35,000m² site where experimental farms and laboratories are situated. Major testing and inspection equipment are listed in Chart A2-19. All of them have been supplied by the Japanese government.

Major test items are as follows:

- (1) Hand tractors
Axle force, durability, fuel consumption, normal clutching force, field performance test, and work capacity, etc.
- (2) Four-wheeled tractors
PTO (power take-out) force, full connecting rod test, axle force, field performance test, etc.

- (3) Pumps
Total head, discharge, pump efficiency, etc.
- (4) Sprayers
Spray pattern, discharge, droplet size, etc.
- (5) Power threshers
Capacity, height of loss, grain quality, etc.
- (6) Rice milling units
Capacity, milling quality, etc.

2.2.5 Other

- (1) Testing and inspection on agricultural machinery

In Indonesia, the Law Concerning Plant Cultivation Systems (Republic of Indonesia Law No.12 of 1992) (UU 12/92 (Undang-Undang Indonesia Nomor 12 Tahun 1992 Tentang Sistem Budidaya Tanaman)) requires machinery and tools for plant cultivation to be tested before marketing (Article 43, Section 3 "Tools and Machinery," Chapter 4 "Production Facilities and Equipment").

In practice, however, manufacturers request the center for conducting tests only when needed for government procurement and other special purposes.

- (2) Standards and testing methods adopted for BBP's testing and inspection

The center relies on RNAM Test Code and Procedure established by Regional Network for Agricultural Machinery of Economic and Social Commission for Asia and the Pacific, and SNI as testing standards and methods.

- (3) Certification

The center does not certify agricultural machinery itself. It performs test and evaluation related to standardization, approval, and regulation of agricultural machinery and issues test reports to both the client and the government.

2.3 PLN-LMK

2.3.1 General

LMK (Pusat Penyelidikan Masalah Keelistrikan) is a part of the organization of PLN (Perusahaan Umum Listrik Negara, State Electricity Corporation) providing and promoting research development and engineering services (RDE) for PLN. These RDE activities were initiated with the establishment of the PLN Central Electricity Testing

Laboratory in 1961. LMK was established in 1964. In its present form, LMK is a continuation of the Power Research Institute. Up to 1970, LMK was separated from PLN and became a government agency. In 1970, LMK was reincorporated to PLN as a service unit.

The LMK Laboratories are grouped together at a single site in Jakarta with the exception of the mini hydro testing station located near the city of Bogor and short circuit laboratory (under construction in Nov. 1994) located at west part of Jakarta.

2.3.2 Activity of LMK

2.3.2.1 Objective

The main activity of LMK is to conduct research and development, and to provide engineering services in the field of electricity in particular and energy in general for PLN, industries, government and consumer.

2.3.2.2 Activities

LMK activities include evaluation, survey, research, development, planning and consultation in the following field of services. To prevent hazard from the use of electricity and to guarantee safety, LMK formulate and develop a concept for regulation, condition, standards and other general specification. For manufacture and related firms of electric machinery and equipment, LMK provides technical guidance, consultation and information services including foreign standards. Chart A2-20 shows number of files of services done by LMK in the last 5 years.

2.3.2.3 Fields of services

- (a) Energy resources
- (b) Power economic
- (c) Electrical power system
- (d) Electrical equipment
- (e) Installation of electrical equipment
- (f) Building construction of electrical installation
- (g) Environmental impacts of electrical installation
- (h) Fuel for electricity
- (i) Fuel gas technology

2.3.3 Current situation

2.3.3.1 Organization

Chart A2-21 shows organization of PLN and Chart A2-22 shows organization of LMK. Chart A2-23 shows organization of Electrical laboratory, Hydro power laboratory, Thermal power laboratory, Research department and Power system laboratory of LMK.

2.3.3.2 Personnel

In September 1993, the number of LMK employees consist of:

94 engineers	(22.1%)
51 technical bachelors	(12.0%)
114 technicians	(26.8%)
166 non technical persons with diverse duties	(39.1%)

In December 1994, LMK's employees totaled 441.

2.3.3.3 Budget

LMK's 1992 budget was Rp. 15,822 million of which Rp. 3,925 million represented capital investment, and Rp. 11,897 million operational cost.

2.3.3.4 Testing capability

LMK can provide following kinds of tests for clients.

- (a) Type test according to national and international standards.
- (b) Acceptance test on delivery of materials.
- (c) Other individual tests to improve the quality of product, i.e. :

Electrical tests and measurements (HV test, short-circuit test, short time current tests etc.)

Mechanical tests and measurements (impact test, tensile strength test, pressure test, vibration test, mechanical endurance test, etc.).

List of equipment and material for electrical installation that could be type tested is shown in Chart A2-24; and Chart A2-25 number of non PLN client in testing and calibration of electrical equipment and material in 1992/1993.

2.3.4 Testing and certification marking system

2.3.4.1 General

For the safety and reliability reasons, the equipment and materials required in installations to be connected to the PLN's network, have to be approved in compliance

with relevant standard and regulation. For approval of the equipment and materials, the manufacturer or importer has to arrange in owning the product type tested. Normally this type, test is carried out by LMK or other independent laboratory. Such test serves to verify its characteristics, e.i. temperature-rise limits, dielectric properties, short-circuit strength, clearances and creepage distances, mechanical characteristics, degree of protection etc.

2.3.4.2 LMK marking system

(1) Features

The principal features of the system are:

- 1) The certification is voluntary
- 2) The certification is operated by an independent laboratory.

The evaluation program consists of:

- a) Type test
- b) factory inspection and surveillance
- c) inspection test of samples taken at random from the factory and from the market.

Up until now the LMK certification system has been established with 28 cable companies (September 1994). Efforts are undertaken to extend the system to other products such as Kwh meters, MCB, distribution transformers etc. In case of cables, only those having an LMK approval mark are allowed to be used either for PLN's installation or installation to be connected to PLN's network.

(2) Objective

The objective of LMK certification marking system is to facilitate identification of electrical materials conforming to certain specifications (standards) with the main purpose of safe guarding public safety.

(3) Standards

In this certification marking system, LMK uses the following standards:

- 1) Indonesian National Standard
- 2) PLN Standard (SPLN)
- 3) IEC Standard

2.4 Materials Research and Testing Institute (Balai Penelitian Bahan DKI Jakarta)(MRTI/BPBJ)

2.4.1 General profiles

BPBJ was established in 1976 as one of regional laboratories operated by state government. Its primary role is to assist in fostering and developing of local industries from the viewpoint of the testing, and research institute specializing in construction materials and metallic materials. BPBJ consists of 6 departments, Construction Materials, Metal, Physics/Chemistry, Research, Development Promotion, and Administration. It is staffed by 23 persons, of which 18 (78%0 belong to operational departments. The organizational chart is shown in Chart A2-26.

2.4.2 Services and activities

(1) Technical Development Service

BPBJ provides technical and development services including research and development related to manufacturing process, technology, and design for small industries, the development of testing methods for various construction materials, and the provision of technical information.

(2) Testing Service

Testing services include testing and chemical analysis of construction materials including cement, clay, asbestos, marble, ceramic, as well as construction steel bars, steel structures, welded wire mesh. BPBJ conducted 183 tests in 1989, 283 in 1990, 270 in 1991, 616 in 1992, and 814 in 1993, indicating rapid increases from 1991 to 1992 (2.3 times) and 1993 (3 times), mainly because of the increase in testing service for construction steel bars. (Chart A2-27)

2.4.3 Budget

BPBJ's operation is entirely funded by the state government budget. From the 1989 - 1993 budget figures (Chart A2-28), the total operating budget doubled from Rp. 153 million to Rp. 284 million over the five year period. Nevertheless, the absolute amount is not large enough in 1993 for the upgrading and adding facilities and equipment. In fact, revenues from testing service have minimal impacts on the total budget, although they increased three-fold from Rp. 2,690,000. in 1989 to Rp. 8,650,000 in 1993. The ratio of service revenues to the total budget is around 3% in 1993 when the largest revenue was

earned. Note that BPBJ is required to transfer revenues from technical service to the state government within 24 hours after their receipt, which thus cannot be incorporated into BPBJ's budget. Clearly, the present system needs to be modified to allow BPBJ to enjoy benefits from their technical service.

2.4.4 Facility and equipment

The facility has total floor area of 1,260m², of which laboratories account for 820m² (65%). While laboratories are well maintained, air-conditioning and lighting are insufficient and floor space seems to be in shortage. BPBJ is planning to add a second floor (1,200m²) to the existing laboratory building to make up for space shortage. The facility is fully equipped with testing equipment for metallic materials and cement including universal testing machines, hardness testers, impact testers, water compression testers, wrapping test machines, welding cutter machines, thickness gauges, hammer test machines, and machine tools and equipment to process a variety of samples (Chart A2-29). While these equipment is well maintained, some of them are nearly 20 years old and outdated. To meet various testing requirements under new standards, they need to be upgraded. Calibration is done by B4T on a contract basis to maintain accuracy of test results.

2.4.5 Other

Testing methods for construction materials are based on 50 SNI standards. 20 items are tested in accordance with international standards such as JIS, ASTM, BS, AS, and ISO.

Testing techniques are improved by sending laboratory engineers to B4T and BBK or receiving experts from the two institutes for training.

3 Private Institutes

3.1 PT. Sucofindo

3.1.1 General profiles

Sucofindo was established in 1956 as the largest private testing, inspection and quality control organization in Indonesia. It has 7 bureaus, Operations 1 and 2 responsible for testing and inspection, Total Quality Improvement in charge of quality control and ISO 9000, Administration, Jakarta Laboratory performing actual testing and inspection services, 20 Branches and Strategic Business Unit.

Jakarta Laboratory consists of 7 departments, namely General Chemistry, Petroleum/Petrochemical, Environment, Mining, Physics, General Affairs, and Personnel Management. It has 143 employees, of which 105 (73%) work for operational departments. 13 out of 20 branches have their own laboratories. The organizational chart is shown in Chart A2-30.

3.1.2 Services and activities

(1) Technical development service

Conducting research and development related to new sampling, inspection and analytical methods for a variety of products including petroleum/petrochemical products, coal, inorganic chemicals, mineral products, metals, agricultural products, and consumer goods, together with technical service for Laboratory Network member organizations.

(2) Testing service

Sucofindo renders broad-based testing and inspection services: including inspection, control, and analysis of petroleum and petrochemical products in the transportation, storage or production process, including crude oil, refined oil, heavy oil, liquefied gas, chemicals, and petrochemical products; the analysis and testing of coal including water content, volatile content, ash content, element analysis, and calorific value; chemical analysis of inorganic materials including ores, limestone, dolomite, clay, slaked lime, gypsum, silica, bentonite, kaolin, feldspar, zeolite, and bauxite; chemical composition analysis of metals and alloys; measurement of gold, platinum, and palladium contents; physical strength tests such as tensile and bending of metals; environmental tests including the analysis of water quality, chemical/physical properties, toxicity, residual agricultural chemicals, and microorganisms in drinking water, industrial water, irrigation

water, and fishing water, the analysis of SO_x, NO_x, NH₃, H₂S, and dust in atmosphere and various exhaust gases, and noise analysis; nondestructive tests including radioactive and ultrasonic testing in the construction and maintenance processes of power plants, oil/gas pipelines, petroleum refineries, chemical plants, and offshore oil rigs; general chemical analysis including quality inspection on textile and apparel products, and raw materials and equipment for medicines; safety tests on toys; the analysis of chemical composition and residual agricultural chemicals in agricultural products including essential oil, vegetable oil, cocoa beans, and tea; and quality inspection and chemical analysis of foodstuff including frozen shrimp, sugar, milk, fish, meat, and fruit.

(3) Calibration service

Sucofindo is a member of National Calibration Network and provides calibration service in two categories of pressure and water content. It asks KIM-LIPI to maintain traceability of its own calibration equipment.

(4) Training service

Sucofindo offers training services in the fields of quality control and ISO 9000.

(Appendix A2-8)

3.1.3 Budget

Sucofindo's revenues from the above services have been growing steadily in recent years, from Rp. 87.4 billion in 1990 to Rp. 104.9 billion in 1991, Rp. 159.1 billion in 1992, and Rp. 243.4 billion in 1993. Taking 1990 figure as a baseline, the 1991 revenues grew 1.2 times, and 1.8 times in 1992 and 2.8 times in 1993, indicating a sharp increase between 1992 and 1993. In particular, revenues of Rp. 243.4 billion (11.6 billion yen) in 1993 are large enough to afford new investment in facilities and equipment. (Chart A2-31)

3.1.4 Equipment

Laboratories are well equipped with ventilation, air-conditioning and lighting systems and kept in good and clean working condition. Only one problem is the shortage of floor space that affects safety of researchers conducting tests. This will be solved in December 1995, when a new laboratory building currently under construction, is completed in the suburbs of Jakarta.

Sucofindo has a variety of new testing equipment required for the above testing services, including atomic absorption spectrometer, ultraviolet/visible spectrophotometer, gas chromatography, high speed liquid chromatography, x-ray equipment, radioactive

testing equipment, ultrasonic testing equipment, and calorimeter. Thus, no equipment require urgent upgrading or replacement at present.

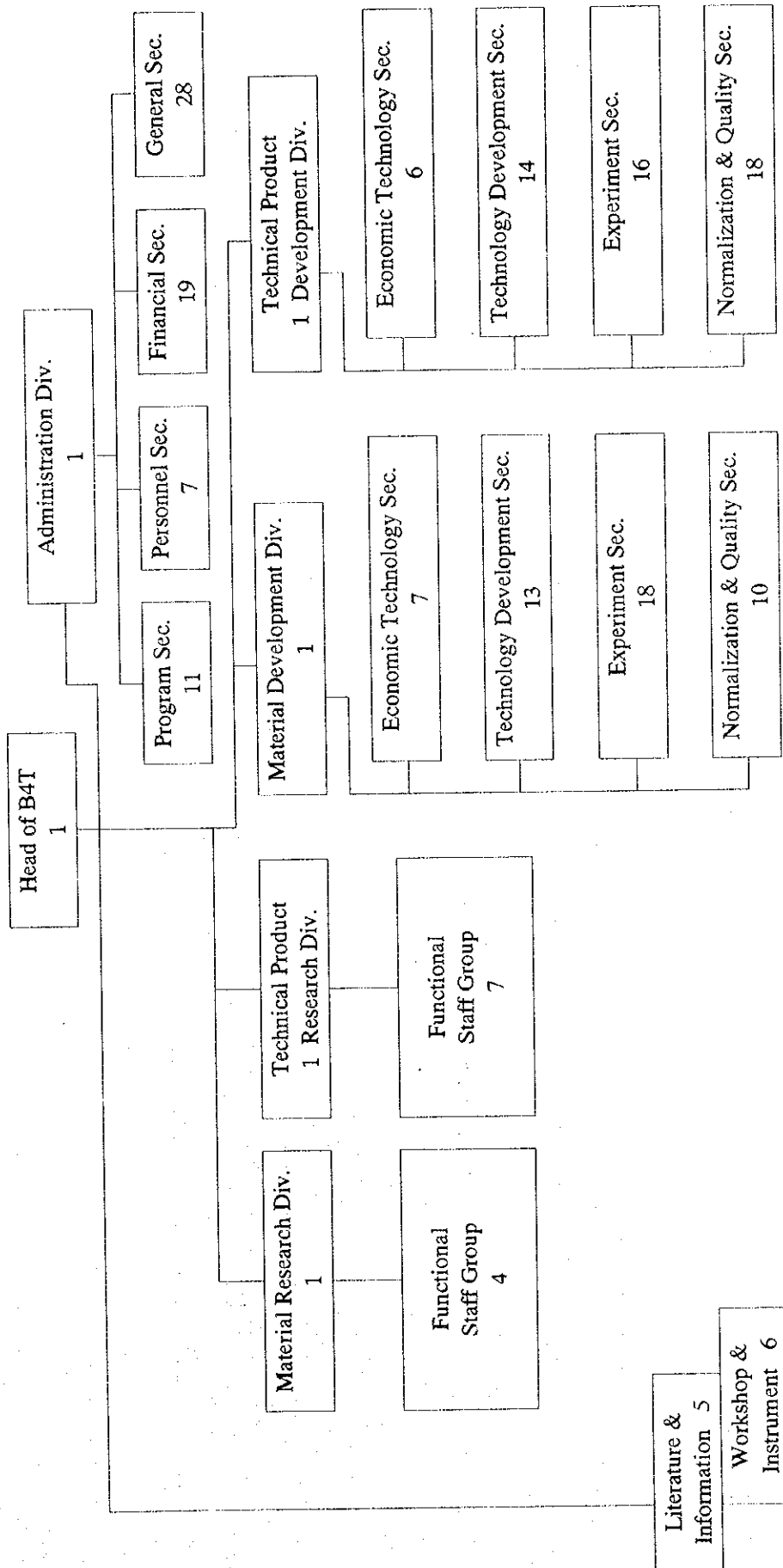
3.1.5 Other

Sucofindo has 20 branches and 19 local offices throughout the country; 7 branches and 7 local offices in Sumatra, 6 and 3 in Java; 3 and 3 in Kalimantan; 2 branches in Sulawesi, and 2 local offices in Irian Jaya.

Of 20 branches, 13 have laboratory facilities and provide testing service. By area of specialization, 9 branches offer testing service in the field of minerals and mining, 8 in general chemical analysis, 8 in environmental fields, 3 in petroleum and petrochemical, and 1 in physical testing. Note that only one branch in Jakarta, offers testing services in the above five areas, while 3 branches handle three areas, 4 branches two areas, and 4 branches having one area. Types of services offered by the branches and local offices are summarized in Tables 30 and 32.

Sucofindo is accredited by NATA (National Association of Testing Authorities) of Australia in July 1993 as a testing organizations for textile and toy. In addition, its coal laboratory in East Kalimantan is accredited by NATA as a coal testing and sampling organization.

Chart A2-1 Organizational Chart of B4T



Note: Figures show the number of staff in the respective division/section

Chart A2-2 No. of Testing/Inspection Services of B4T during Past 5 Years

No.	Field	1988/1989	1989/1990	1990/1991	1991/1992	1992/1993	Total
1	Testing	16,384	12,809	17,238	17,841	18,661	82,933
	Materials/Products						
	Pressure	138	131	136	126	150	681
	Force	361	363	369	433	408	1,934
2	Calibration	4	5	1	2	1	13
	Temperature						
	Length	33	33	36	42	38	182
	Masses	36	35	39	45	53	208
	Sub-total	572	567	581	648	650	3,018
3	Certification	0	9	13	5	4	31
	Quality System						
	Product	5	17	43	49	60	174
4	Technical Inspection	5	5	4	4	4	22
	Technical Inspection						
	Failure Analysis	0	0	5	7	7	19
5	Training	97	216	407	332	325	1,377

Chart A2-3 Budget and Revenue of B4T during Past 5 Years

(Unit : '000 Rp.)

Items	1989	1990	1991	1992	1993
Routine	531,000	567,000	618,000	714,000	830,890
Development	74,000	124,000	207,000	280,000	339,210
Revenue	655,000	996,000	1,052,000	1,369,000	2,001,500
Total	1,260,000	1,687,000	1,877,000	2,363,000	3,171,600

Chart A2-4 List of Equipments, B4T (1/6)

No.	Name of Equipments	Brand-Name/Specification	Number	Year of Service Since
I <u>Equipments for Non Destructive Test Laboratory</u>				
1.	Control box X-ray 200 KV, complete with X-ray tube	Eresco AS 2	1	1982
		Eresco 200, ϕ 8	1	1982
2.	Camera container	Gamma Mat T1 max. 200Ci, Ir-192	2	1975
3.	Survey meter 0-1000 mR/h	Victorin	1	1982
4.	Ultrasonic flaw detector	USL-2 Kraut Kramer	1	1982
		USL-6 Kraut Kramer	1	1981
		USL-2 Kraut Kramer	1	1975
5.	Magnetic particle	Tiede Prod type model	1	1975
6.	Crack depth meter	Kraut Kramer Bronson, RXT-705	2	1975
II <u>Equipments for Materials Behavior test laboratory</u>				
II. 1 <u>Equipments for Specimen Preparation</u>				
7.	Saw Machine	Do All	1	1912
8.	Saw Machine	Carl Schleper	1	1955
9.	Circular Saw Machine	Metora MKS 32	1	1978
10.	Planer Machine	Ruhaak	1	1912
11.	Planer Machine	Atlas	1	1912
12.	Planer Machine	Sacia	1	1981
13.	Lathe Machine	Lindetapes	1	1912
14.	Lathe Machine	Wade	1	1912
15.	Lathe Machine	Plasma 1976	1	1912
16.	Milling Machine	Schuchardt & Schotie Horison	1	1912

Chart A2-4 List of Equipments, B4T (2/6)

No.	Name of Equipments	Brand-Name/Specification	Number	Year of Service Since
17.	Drilling Machine	The Driver	1	1912
18.	Drilling Machine	Netaba	1	1976
19.	Drilling Machine	Hunter	1	1981
20.	Tool Grinding Machine	Imperia	1	1950
21.	Grinding Machine	Hitachi	1	1972
22.	Oxygen Cutting Machine		1	1982
II.2 <u>Equipments for Destructive Test</u>				
23.	Universal Testing Machine, 300 ton Capacity	Amsler	1	1912
24.	Universal Testing Machine, 100 ton Capacity	Tokyo Testing Machine, MFG, Co.	1	1980
25.	Universal Testing Machine, 50 ton Capacity	Amsler	1	1912
26.	Universal Testing Machine, 20 ton Capacity	Amsler	1	1912
27.	Universal Testing Machine, 5 ton Capacity	Gebruder	1	1912
28.	Wire Torsion Testing Machine, 6 kgm Capacity	Amsler	1	1912
29.	X-Y Recorder Complete, with Electric Extensometer	Torse Type P xy 11	1	1977
30.	Dividing Machine for Test Bar	DT 1	1	1979
31.	Micro Hardness Tester	Zwick	1	1974
32.	Universal Hardness Tester	Frankoskop	1	1975
33.	Rockwell Hardness Tester	Wilson	1	1979

Chart A2-4 List of Equipments, B4T (3/6)

No.	Name of Equipments	Brand-Name/Specification	Number	Year of Service Since
<u>II.3 Equipments for Metallographic Examination</u>				
34.	Specimen Preparation Equipment for Microscopic Examination	Struers	1	1970
35.	Portable Specimen Preparation Equipment for Field Microscopic Examination	Struers	1	1970
36.	Stereo Microscope, 32X Magnitude Maximum	Wild	1	1920
37.	Metallurgical Microscope, 5-1500 X Mag.	Wild	1	1973
38.	Metallurgical Microscope, 5-1500 X Mag.	Leitz	1	1972
39.	Box Furnace, Max., Temp. 1,000°C	Galenkamp	1	1980
40.	Specimen Mount Press.	Buhler	1	1983
<u>III. Equipments for Calibration Activity</u>				
41.	Calibration Boxes 60,300 ton Capacity	Amsler	1	1955
42.	Proving Ring, 300 - 200,000 lbs. cap.	More house	1	1951
43.	Calibrating Manometer, 0 - 2000 atm.	Nagano	1	1978
44.	Pressure Gauge Tester, 300 atm.	Amsler	1	1951

Chart A2-4 List of Equipments, B4T (4/6)

No.	Name of Equipments	Brand-Name/Specification	Number	Year of Service Since
<u>IV. Equipments for Materials Chemical</u>				
<u>Behavior Test Laboratory</u>				
<u>IV.1 Equipments for Corrosion Test</u>				
45.	Potensiostat and Electrode	PRP 20-2 A	1	1978
46.	Salt Spray	Type 411.1 AC	1	1972
47.	Humidity Test	Type GK 500	1	1973
48.	Gas Corrosion	PK 125	1	1973
49.	Multi Combination Meter	Model B-3	1	1973
<u>IV.2 Equipments for Inorganic Chemistry</u>				
50.	Carbon and Sulphur determination on steel	Strohlein	1	1977
51.	Electrodeposit Analyser	Gallenkamp	1	1980
52.	Electric Furnace	Gallenkamp	1	1972
53.	Flame Photometer	Gallenkamp	1	1978
54.	Spectrophotometer	Hach	1	1979
55.	Nitrogen Determining	Kjeldhl	1	1979
56.	Emission Spectrometer	Shimizu Cum 500	1	1982
57.	Infra Red Spectrometer	Pye Unican	1	1978
58.	Gas Chromatography	Packard	1	1972
59.	Oven	Nemmert	1	1980
<u>IV.3 Equipments for Organic Chemistry</u>				
60.	Organic Combustion	Sisker no. 13562	1	1975
61.	Thin Layer Chromagrapy	Desaga	1	1977

Chart A2-4 List of Equipments, B4T (5/6)

No.	Name of Equipments	Brand-Name/Specification	Number	Year of Service Since
62.	Foaming Characteristic of crank case oils.	Seta 5383	1	1978
63.	Dropping point of Lubricating Creases.	Seta 1170		
64.	Cloud and pour point automatic frigistat	Seta 1402	1	1978
65.	Titrimeter II Manual System	230-50 Hz	1	1981
66.	Crypto Meters	Lapine Scientific cat.C. 319-46 A.	1	1981
67.	Drying Time Recorder	Erichsen	1	1978
68.	Polarimeter	Mod. SI. 83	1	
69.	Colorimeter	ASIMD-1500	1	1976
70.	Colorimeter	Janke-Kiukal	1	1912
71.	Viscometer	Papst	1	1912
72.	Electric Multiple Furnace	Braun-Knecht Heimann Co.	1	1912
73.	Penetrometer	Inventum	1	1912
74.	Refractometer	ABBO	1	1912
75.	Tri roll mill & Ball mill.	NYF Res D 75	1	1912
76.	Microscope	Phillips	1	1912
77.	Thicknessmeter	Forsterr Monimeter	1	1983
V <u>Equipments for Electric and Technical Products</u>				
78.	Paper recorder	Hioki	1	1982
79.	Deta Logger and Scanner, 160 channel cap.	Fluke	1	1982

Chart A2-4 List of Equipments, B4T (6/6)

No.	Name of Equipments	Brand-Name/Specification	Number	Year of Service Since
80.	Oscilloscope	Tektonix	1	1971
81.	Digital Multimeter	Fluke	1	1980
82.	Power Factor Mater	Yokogawa	1	1980
83.	High Voltage Meter	Yokogawa	1	1980
84.	Dermitron Thickness Meter	UPA		
85.	Variable Transformer	Matsunaga	1	1971
86.	Discharge test for dry battery	Lab. Assembly	1	1977
87.	Lathe Machine	Atlas	3	1951
88.	Scrape Machine	Atlas	1	1951
89.	Drilling Machine	Ryobi	1	1982
90.	Tool set	Tone	2	1980
91.	Furnace complete with Temperature control	Fisher	1	1980
92.	Tensile Testing Machine	Shimadon	1	1983
93.	Universal Testing Machine	Shimadon	1	1983
94.	Planer Impact Tester	Rarl Frank	1	1951

Chart A2-5 Organizational Chart of Institute for Research and Development of Metal and Machinery Industries (Since 1988)

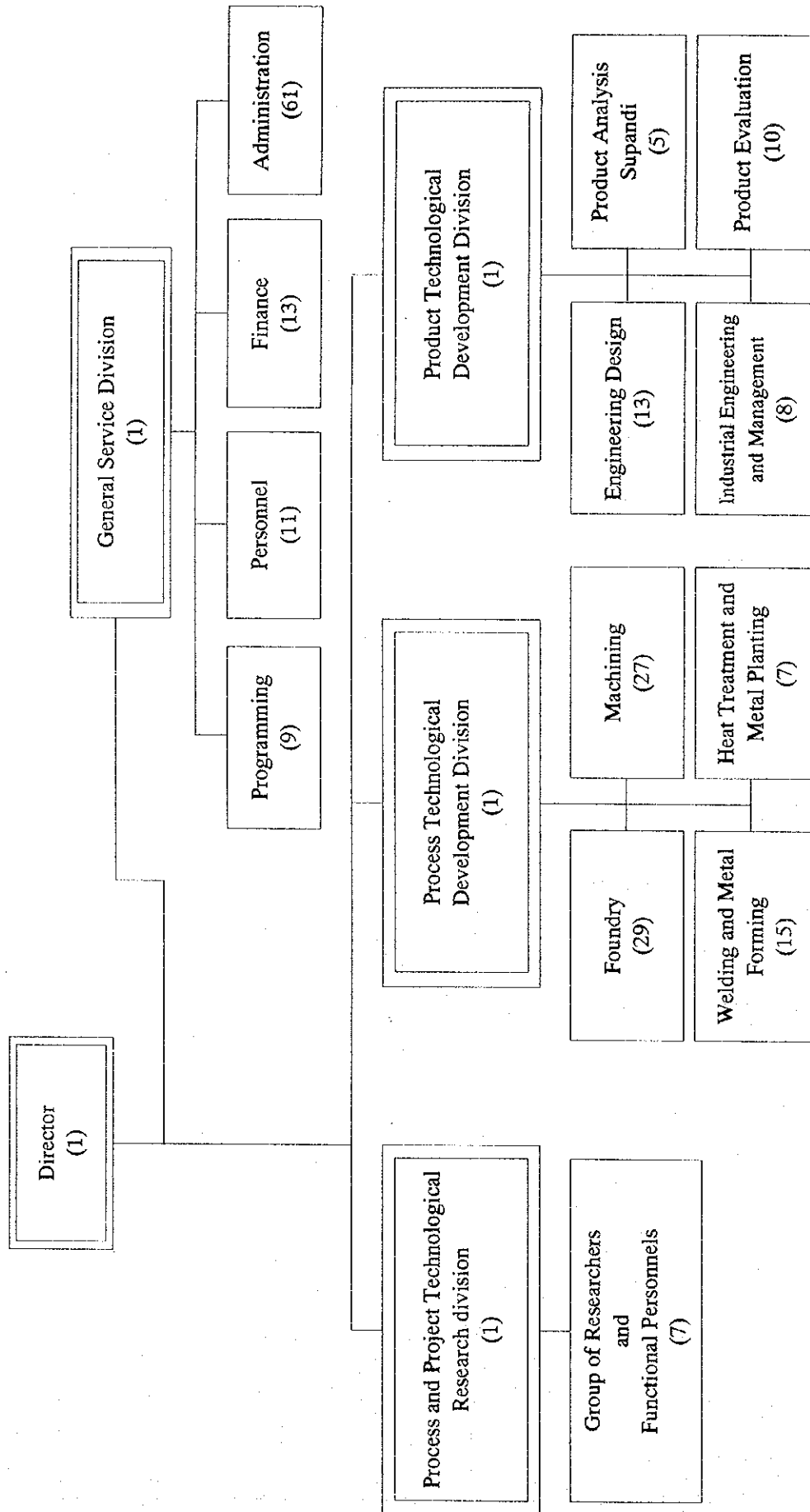


Chart A2-6 Budget and Revenue of BBLM during Past 4 Years

(Unit : '000 Rp.)

Items	1991	1992	1993	1994
Budget	about 1,000,000	about 1,000,000	about 1,000,000	about 1,000,000
Tech. Development	350,620	638,810	683,470	868,520 (6 months)
Revenue	(1,300)	(2,590)	(11,880)	-
Total	1,350,620	1,638,810	1,683,470	1,868,520

Chart A2-7 List of Equipment Existing at the MIDC

1. FOUNDRY SHOP

1.1. Metal & Metallography Laboratory

No.	Description	Quantity	Type
1.	Surfmet grinder abrasive	1 Unit	Buchler
2.	Polishing machine	2 Unit	Struer
3.	Electrolyseur	1 Unit	Clif HM
4.	Orsat gas analysis	1 Unit	Chassant/HM
5.	Magnetic stirrer	1 Unit	Heidolf
6.	Heater/cook plate	2 pcs	Jouan
7.	C.S Strohlein	1 Unit	Strohlein
8.	Heating furnace	1 Unit	Analisis 1250°
9.	Drying oven	1 Unit	Nummert 220°
10.	Balance	1 Unit	Mettler PN 1210
11.	Balance	1 Unit	Bosch/S 2000
12.	Microscope metapan	1 Unit	Reichert
13.	Polishing machine	1 Unit	AP 1 Struers
14.	Hardness tester	1 Unit	Royton minor
15.	Nitrogen apparatus	1 Unit	Strohlein
16.	Hardness tester	1 Unit	Scleris Co. Pc
17.	Electro analysis apparatus	1 Unit	Eberbach Corp.
18.	Water distilling equipment	2 Unit	Exelo
19.	Accessories for all laboratory facilities	1 set standard	

1.2. Sand Laboratory

No.	Description	Quantity	Type
1.	Laboratory sifter	2 Unit	RSA/CF
2.	Jolt squeeze apparatus	1 Unit	-
3.	Wett tensile strength	1 Unit	P M F
4.	Central controller	1 Unit	P Z S
5.	Compressive strength	1 Unit	P D S
6.	Universal strength tester	2 Unit	P F A
7.	Sintering furnace	1 Unit	P S O
8.	Checking device	1 Unit	P K V
9.	Agitator	1 Unit	P E D
10.	Sand rammer	2 Unit	P R A
11.	Hygrometer	1 Unit	P R A N
12.	Permeability tester	2 Unit	P D V
13.	Infrared rapid dryer	2 Unit	P T T
14.	Stereoscopic microscope	1 Unit	46/RT/428
15.	Drying oven	1 Unit	Cheiret
16.	Lab. Furniture	1 pc	PO1 Funchois
17.	Matler balance	1 Unit	P 2000 N
18.	Flow ability tester	1 Unit	P F S
19.	Lab. Mixer	1 Unit	STD/59/270/PRAM
20.	Sand sample container	1 set	PSN + PFI
21.	Continuous clay washer	1 Unit	P K A
22.	Foundry sand picnometer	1 Unit	P P M
23.	Turbo mixer	1 Unit	M S D
24.	Lab. mixer	1 Unit	P L K
25.	Dilato meter	1 Unit	P D L
26.	Green tensile strength tester	1 Unit	P F Z
27.	Core hardness tester	1 Unit	P K E
28.	Mould hardness tester	1 Unit	P P N
29.	Simple splitter	1 Unit	P R T

1.3. Pattern Shop

No.	Description	Quantity	Type
1.	Circular saw	1 Unit	Kamro SK
2.	Band saw machine	1 Unit	Danckaert
3.	Combined planing machine	1 Unit	Eurem
4.	Milling machine	1 Unit	Vertongen
5.	Disk sander	1 Unit	Ducuroir
6.	Drilling machine	1 Unit	Ducuroir
7.	Spindle sander	1 Unit	Kitten 3
8.	Small drilling machine	1 Unit	Gloria W
9.	Abrasive band machine	1 Unit	Sleer MD 2
10.	Dust collector	1 Unit	Vertongen
11.	Automatic grinding machine	1 Unit	Ducuroir
12.	Tools grinding machine	1 Unit	Vertongen
13.	Vertical abrasive machine	1 Unit	Flan
14.	Hot melt hand gun	1 Unit	AD 25
15.	Electric band saw welder	1 Unit	Ideal BS 2
16.	Band saw grinder	1 Unit	Ideal SR 60
17.	Portable router	1 Unit	Metta 41570 B
18.	Universal milling machine	1 Unit	Wadkin
19.	Wood lathe machine	1 Unit	Jimnerman
20.	Planing cutter grinder	1 Unit	Vertongen
21.	Work Bench	2 Unit	
22.	Various cutting tools	1 set	
23.	Hand tools for wood working	1 set	
24.	Vernier caliper for pattern making	2 pcs	

1.4. Moulding Equipment

No.	Description	Quantity	Type
1.	Sand preparation unit	1 Unit	A Marllier
2.	Moulding machine	1 Unit	S 600 B
3.	Moulding machine	1 Unit	S 800 B2
4.	Ribbon flow mixer	1 Unit	L 22
5.	Sand mixer	1 Unit	Zamix
6.	Core blowing machine	1 Unit	Vergel
7.	Drying oven	1 Unit	C 22
8.	Pneumatic hoist	2 Unit	-
9.	Compressor	1 Unit	Atlas copco
10.	Core work bench	2 Unit	Pram torino
11.	Sand dryer	1 Unit	L 42
12.	Mould drying furnace	1 Unit	-
13.	Roll conveyer	2 Unit	
14.	Set of hand tools for sand mould repair	1 set	

1.5. Melting Furnaces & Equipment

No.	Description	Quantity	Type
1.	Cupola	1 Unit	Cold Blast
2.	Shot Blast Equipment	1 Unit	Scission Latherm
3.	Shake Out Machine	1 Unit	AM 100 LV 4
4.	Fuel Pump	1 Unit	A E G
5.	Ladle Heating	1 Unit	Monometer
6.	Induction Furnace	1 Unit	Elphiac
7.	Bale Out Furnace	1 Unit	Monometer
8.	Tilting Furnace	2 Unit	Monometer
9.	Grinding Machine	1 Unit	Roma
10.	Pneumatic Grinding Machine	2 Unit	Ingersolf Rand
11.	Gantry Crane, 2 ton	1 Unit	Verlindo
12.	Rotary Furnace	1 Unit	Monometer
13.	Pyrometer Digital	1 Unit	Mark II
14.	Thermocouple Tube	1 set	Pyro
15.	Carbon Equivalent Matic	1 Unit	Leeds & Northrup
16.	C E Meter	1 Unit	Electro - N I T F
17.	Weighing Scale (500 Kg. cap)	1 Unit	Berkel
18.	Optic Pyrometer	1 pc	-
19.	Radiation Pyrometer	1 set	Raynger
20.	Immertion Pyrometer (steel) (Digital)	1 set	Pyro
21.	Immertion Pyrometer (non Ferro)	1 set	Pyro

2. MACHINE SHOP

2.1. Metrology

No.	Description	Quantity	Type
2.1.1.	LINEAR MEASURING TOOLS		
1.	Vernier Caliper	4 pcs	Inox Kursel
		14 pcs	Mitutoyo
		2 pcs	Etalon Rolle
		10 pcs	C E J
2.	Depth Caliper	3 pcs	Tesa
		2 pcs	Roch France
3.	Gear Vernier Caliper	1 pc	Roch France
4.	Outside Micrometer	13 pcs	Tesa
		6 pcs	Mitutoyo
		2 pcs	Mitutoyo
		15 pcs	Rolle
		4 pcs	Hellios
		3 pcs	Uchida
5.	Depth Micrometer	2 pcs	Tesa
		2 pcs	Mauser
6.	Inside Micrometer	20 pcs	Tesa
7.	Disc Type Micrometer	4 pcs	Tesa
8.	Tube Micrometer	1 pc	
9.	Taper Micrometer	3 pcs	Mitutoyo
10.	Groove Micrometer	2 pcs	Steinmeyer
11.	Screw Thread Micrometer	6 pcs	Tesa
12.	Blade Type Micrometer	4 pcs	Steinmeyer
13.	Mul - T - Anvil Micrometer	2 pcs	Starrett
14.	Uni Micrometer	2 pcs	Starrett
15.	Spline Micrometer	2 pcs	Mitutoyo
16.	Cylinder Gage (Pen Caliper)	1 set	Stiel Moyer (0, 10 - 6, 00) & (6, 10 - 10, 00)
17.	Point Caliper	2 pcs	Starrett
18.	Outside Caliper	2 pcs	Starrett
19.	Inside Caliper	2 pcs	Starrett
20.	Micrometer Head	2 pcs	Mauser
21.	Inside Micrometer (Three Point)	4 set	Tesa

No.	Description	Quantity	Type
22.	Pen Caliber	1 set	Carry – Lolocle (1 – 3, 5)
		1 set	(3, 6 – 6)
		1 set	(5, 1 – 10)
23.	Dial Snap Gage	1 set	Carl Mahr
2.1.2.	MEASURING STANDARD & CALIBERS		
1.	Gauge Block	1 set	Robert Bosch, PN (class 1,001 – 100,00)
		1 set	CEJ – NJTA (class 00, 46 pcs)
		1 set	Steilmeyor (103 pcs)
		1 set	PM – XCV (66 pcs)
		1 set	PM – XDV (46 pcs)
		3 set	Germany
2.	Height Master	1 Unit	Verdict
3.	Extension for Height Master	2 pcs	(150 & 300)
4.	Co and Not Co Gages, Inside	1 set	MORHARD (7 – 25 H ₇)
	Outside	1 set	(4 – 50 H ₇)
5.	Taper Plug Gage	1 set	CSE (0 – 6)
6.	Taper Ring Gage	1 set	CSE (0 – 6)
7.	Screw Thread Ring Gage	1 set	CSE (M ₃ – M ₂₄ – 6g)
8.	Screw Thread Plug Gage	1 set	CSE (M ₃ – M ₂₄ – 6 H)
9.	Pen Caliber	1 set	Stiofel Moyor (1, 01 – 2, 00)
		1 set	(2, 01 – 3, 00)
		1 set	(3, 01 – 4, 00)
		1 set	(4, 01 – 5, 00)
		1 set	(5, 01 – 6, 00)
2.1.3.	COMPARATOR		
1.	Dial Indicator	11 pcs	Kaovor
2.	Pupitast	5 pcs	Tesa
3.	Dial Indicator for Inside Diameter	1 pc 2 pcs	Carl Mahr Tesa

No.	Description	Quantity	Type
4.	Milliness	14 pcs	Carl Mahr
5.	Tesastast	12 pcs	Tesa
6.	Microcator	1 Unit	C E J
7.	Electronic Comparator	1 Unit	Tesa Modul
8.	Ultra Comparator & Accessories	1 Unit	Zeiss Yona
2.1.4.	ANGLE MEASURING TOOLS		
1.	Angle Protactor	1 pc	EAX 2 – Tesa
		1 pc	Hellios
		1 pc	Marwa
		1 pc	Rolic
2.	Sine Rule	2 pcs	Carl Mahr
3.	Sine Table (Double Inclination)	1 pc	Britte
4.	Sine Table with Centering	2 pcs	Jones – Shipman
5.	Sine Linier	2 pcs	KS (Germany)
6.	Sine Table with Centering Device	1 Unit	Jones – Shipman
7.	Precision Squares		Tesa & Carl Mahr
2.1.5.	SURFACE ROUGHNESS INSTRUMENT & ROUGHNESS TESTER		
1.	Surface Roughness Standards	1 set	Etalon
2.	Surface Roughness Tester	1 Unit	Normal/P ₄
3.	V – Anvil Micrometer	4 pcs	Tesa
4.	Concentricity Tester (Electronic + Centering Device)	1 Unit	Tesa
2.1.6.	FLATNESS INSTRUMENT & TOOLS		
1.	Straight Knife	1 set	Tesa (50 – 150)
2.	Spirit Level	1 pc	Etalon
3.	Measuring Rule	5 pcs	Presser
4.	Optical Parallel	5 pcs	Zeiss Yena
5.	Optical Flat	3 pcs	Mitutoyo
6.	Triangular edge	2 pcs	Tesa
7.	Flat Straight Edge	5 pcs	Tesa
8.	Parallel Flat (Granalt)	2 pcs	Tesa
9.	Bevel Rule	3 pcs	Tesa
10.	Autocollimator	1 Unit	Nikon
11.	Bridge	1 pc	Tesa

No.	Description	Quantity	Type
2.1.7.	PROFILE MEASURING INSTRUMENT, GEARS & SCREW THREAD		
1.	Universal Gear Measuring Machine + Accessories	1 Unit	Carl Mahr
2.	Measuring Wires for Thread	16 set	Tesa (0, 17 - 3, 20)
3.	Screw Thread Gauge (Metric)	1 set	
4.	Screw Thread Gauge (with worth)	1 set	
5.	Profile Projector + Accessories	1 Unit	Nikon 6 c
2.1.8.	TRACING & LEVELING EQUIPMENT		
1.	Tracing Block	2 pcs	Tesa
2.	Flat Table		
	* Microflat 1525 x 915 x 203 mm	1 pc	
	* Diabase 630 x 630 x 100 mm	1 pc	
	* Pelt & Hooykaan BV 500 x 400 x 90 mm	1 pc	
3.	Square	8 Unit 6 Unit	Tesa Carl Mahr
4.	Mounting Square	4 pcs	C E J
5.	Universal Square	2 pcs	Tesa
6.	V - Block	2 pcs	Tesa
7.	V - Block (Granite)	2 pcs	Microflat
2.1.9.	MEASURING MACHINE		
1.	Universal Length Measuring Machine + Accessories	1 Unit	Zeiss Yona
2.	Length Measuring Machine + Accessories	1 Unit	Zeiss Yona
3.	Ultra Comparator Accessories	1 Unit	Zeiss Yona
4.	Optical Dividing Head	1 Unit	Ex. P9. LTD
5.	Coordinate Measuring Machine	1 Unit	Olivetti
6.	Coordinate Measuring Machine	1 Unit	Bendix Cordax
7.	Tool Maker's Microscope +	1 Unit	Marcel Aubert SA MA 140 - 254

No.	Description	Quantity	Type
2.1.10.	MISCELLANEOUS		
1.	Test Mandrel (Cylindrical)	1 pc	Tesa
2.	Accessories for Endgauge	2 set	PM
3.	Accessories for Dial Indicator		
	* Magnetic Stand	7 pcs	Tesa
	* Universal Stand	4 pcs	Tesa
4.	Thermohydrography Meter	1 Unit	BTN

2.2. Machine Tools

No.	Description	Quantity	Type
1.	Universal Turret Lathe	1 Unit	Jones & Lampson
2.	Automatic Copying Lathe	1 Unit	Gallicop
3.	Precision Lathe C 13	1 Unit	Vuillumer Preras
4.	Universal Precision Lathe	1 Unit	Celtic 14
5.	Universal Precision Lathe	1 Unit	Celtic 20
6.	Universal Lathe	1 Unit	Gurutype
7.	Jig Boring Machine	1 Unit	Matheys 3 A
8.	Jig Boring Machine	1 Unit	SIP MP 5 E
9.	Universal Milling Machine	1 Unit	Vicking
10.	Tool Milling Machine	1 Unit	Deckel
11.	Vertical Milling Machine	1 Unit	Klopp FS 11
12.	Universal Milling Machine	1 Unit	Doufour
13.	Tool Milling Machine	1 Unit	Aciera
14.	Boring & Milling Machine	1 Unit	Pegard
15.	Copy Milling Machine	1 Unit	Deckel
16.	Tool Milling Machine	1 Unit	Maho
17.	Shaping Machine	1 Unit	Klopp
18.	Punch & Electrode Shaping Machine	1 Unit	Thiel Conturex 132
19.	Precision Filing & Sawing Machine	2 Unit	Thiel Produro 115
20.	Radial Drilling Machine	1 Unit	Richmond
21.	Inclinable Power Press	1 Unit	Scholar
22.	Electric Discharge Machine (EDM)	1 Unit	Agietron 45 SL
23.	Electric Discharge Machine	1 Unit	Agic 60 SL
24.	Surface Grinding Machine	1 Unit	E L B
25.	Cylindrical Grinding Machine	1 Unit	CC 5019
26.	Optical Grinding Machine	1 Unit	Wickman
27.	Surface Grinding Machine	1 Unit	John & Shipman
28.	Drilling Machine	1 Unit	Solid
29.	Drilling Machine	1 Unit	Overbroock
30.	Surface Grinding Machine	1 Unit	L I P H
31.	Gear Hobbling Machine	1 Unit	Lorenz
32.	Precision Drilling Machine	1 Unit	Cordia
33.	Hack Saw	1 Unit	Kasto HBS 280
34.	Band Saw	1 Unit	Pohaka USM - 4
35.	Abrasive Cut off Wheels	1 Unit	Buckler
36.	C N C Lathe	1 Unit	Galic 420
37.	Hack Saw	1 Unit	Kasto UMS 150
38.	Flat Table (Cast Iron) 750 x 1000	1 pc	
39.	Flat Table (Cast Iron) 1000 x 2000	1 pc	
	Note : Each machine is equipped with accessories and attachments.		

2.3. Tool Resharpener Machines

No.	Description	Quantity	Type
1.	Grinding Machine	1 Unit	A E G
2.	Universal Tool Sharpening Machine	1 Unit	Khulman
3.	Drill Sharpener	1 Unit	Meteor
4.	Tool Sharpener	1 Unit	Wilhem Simon K 6

Note : Each machine is equipped with accessories and attachments.

3. WELDING AND METAL FORMING SHOP

3.1. Destructive & Non Destructive Testing Equipment

No.	Description	Quantity	Type
1.	Universal Testing Machine	1 Unit	Mecatec
2.	Impact Test	1 Unit	Mecatec PSW 15
3.	Hardness Tester (Rockwell)	1 Unit	Minor
4.	Hardness Tester (Brinnell)	1 Unit	Hoyton
5.	X - Ray	1 Unit	Balteau Block
6.	Magnetic Particle	1 Unit	Magna Flux
7.	Ultrasonic	1 Unit	Usif 10 W
8.	Hardness Tester	1 Unit	Proceq
9.	Hardness Tester (Poldy Hammer)	1 Unit	Welca

3.2. Plate Working Machines

No.	Description	Quantity	Type
1.	Plate Bending Machine	1 Unit	Verlessted
2.	Pipe Bending Machine	1 Unit	Herber
3.	Hydraulic Shear Cutting Machine (3 mm cap.)	1 Unit	L V D
4.	Hydraulic Press Brake Machine	1 Unit	L V D
5.	Portal Press (1000 Kg)	1 Unit	L V D
6.	Hand Combined Shear	1 Unit	Muboa
7.	Small Hand Plate Shear	1 Unit	3/5 R
8.	Drilling Machine	1 Unit	Vena 30
9.	Nibbling Machine	1 Unit	Pullmax
10.	Grinding Machine	1 Unit	Roma
11.	Hand Plate Shear (1.2 mm cap.)	1 Unit	MAF - M
12.	Hand Shear Cutting (1.5 mm cap.)	1 Unit	Gardier SA
13.	Hand Roll Machine	1 Unit	Gardier/GSR
14.	Profile Roll Machine	1 Unit	MF - F
15.	Hand Punch Machine	1 Unit	Gardier SA

3.3. Oxy - Acetylene Welding Equipment

No.	Description	Quantity	Type
1.	Oxy Acetylene Copier Cutting Machine	1 Unit	Novitome
2.	Oxy Acetylene Copier Cutting Machine	1 Unit	Multitome
3.	Manual Pipe Cutter Oxy Acetylene	1 Unit	H & M Zc - Zo
4.	Pipe Beveling Machine	1 Unit	RST - 1
5.	Plasma Cutting Equipment	1 Unit	S A F
6.	Oxy - Acetylene Welding Torch	2 set	

3.4. Arc Welding Equipment

No.	Description	Quantity	Type
1.	Welding Rectifier 500 A	1 Unit	Hobart 400 S
2.	Welding Rectifier 400 A	1 Unit	Esab LHF 400
3.	Welding Rectifier 400 A	1 Unit	Logera - Welca
4.	Welding Rectifier 500 A	1 Unit	Logera - Dalex
5.	Welding Transformer Rectifier 500 A AC/DC	2 Unit	Morelisse EG 501
6.	Welding Transformer 250 A	3 Unit	Philips PZ 2038
7.	Welding Transformer 325 A	1 Unit	Philips PZ 2018
8.	Welding Transformer 700 A	2 Unit	Philips PZ 2040
9.	Welding Transformer 300 A	3 Unit	Soudometal ST 301
10.	Welding Transformer 300 A	1 Unit	Soudometal SEB 300
11.	Welding Transformer 300 A	5 Unit	Arcos 300 Rc
12.	Welding Transformer	1 Unit	PZ 208 MBLE
13.	Welding Transformer	1 Unit	Soudometal
14.	Mig Welding Machine	1 Unit	Hobart RC 607
15.	Mig Welding Machine	1 Unit	HM Mega MID 300
16.	Mig Welding Machine	1 Unit	Arcos CP 350
17.	Mig Welding Machine	1 Unit	Soudometal EH 60 RD
18.	Tig Welding Machine	1 Unit	Hobart Cyber Tig IT
19.	Tig Welding Machine	1 Unit	Hobart CT 300/DC
20.	Tig Welding Machine	1 Unit	Arcos Arcodyne 37
21.	Circomatic Automatic	1 Unit	Arcos DL
22.	Vertomatic Automatic	1 Unit	Arcos T
23.	Spot Welding Machine	1 Unit	PM 2
24.	Spot Welding Machine	1 Unit	SAF/P 33
25.	Stud Welding Machine	1 Unit	Philips
26.	Automatic Welding Machine	1 Unit	Esab - A 6
27.	Automatic Welding Machine	1 Unit	Arcos
28.	Miller Welding Machine	1 Unit	Blazer

4. HEAT TREATMENT & METAL PLATING SHOP

4.1. Heat Treatment and Metal Plating Equipment

No.	Description	Quantity	Type
1.	Induction Heating	1 Unit	H G L 850
2.	Sand Blasting Equipment	1 Unit	IDE PLUG
3.	Tempering Furnace	1 pc	Degussa
4.	Salt Bath	5 pcs	Degussa
5.	Quenching Tank	2 pcs	
6.	Salt Container	1 pc	
7.	Electric Hoist (500 Kg)	1 Unit	
8.	Muffle Furnace	1 pc	
9.	Cleaning Installation	1 Unit	
10.	Metal Plating Bath	1 lot	
	Note : Each Furnace is equipped with thermocouple and temperature control		

5. UNCLASSIFIED ITEMS

No.	Description	Quantity	Type
1.	Cutting Tools (Single Point Tools, Milling Cutters, Twist Drills, Carbade Tool Tips & Holders Special Cutting Tools)		
2.	Hand Tools for Mould Making		
3.	Hand Tools for Pattern Making		
4.	Supplies (Additive Materials) for Melting		
5.	Supplies for Metal Lab., Sand Lab. and NDT & DT Lab.		
6.	Welding Consumables		
7.	Spare Parts for Machines and Equipment		
8.	Tool Steels for Die Making		

6. MISCELLANEOUS ITEMS

No.	Description	Quantity	Type
1.	Computer + Printer (PC IBM COMPATIBLE)	1 Unit	
2.	Computer + Printer	1 Unit	Apple II
3.	Mobile Unit	1 Unit	Daihatsu

7. Name of Facilities and Equipments for the Testing of Metal Working (1/3)

Item	Name	Q'ty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
							Method	Freq.	Method	Freq.
1.	Digital Outside Micrometer		1992	JAPAN	Cap: 2-3" Res: 0.001 mm	Good New	JIS	1 year		
2.	Digital Outside Micrometer		1992	JAPAN	Cap: 75 - 100 mm Res: 0.001 mm	Good New	JIS	1 year		
3.	Vernier Caliper		1992	JAPAN	Cap: 300 mm Grad: 0.02 mm	Good New	JIS	1 year		
4.	Dual Depth Gauge		1991	JAPAN	Cap: 300 mm Grad: 0.05 mm	Good New	JIS	1 year		
5.	Mini Scope		1992	JAPAN	Mag: 50 X	Good New				
6.	Pocket Comparator		1992	JAPAN	Comparator: 10 X	Good New				
7.	Surface Roughness Tester		1992	JAPAN	Range: Ra, Rg: 40 μ m/0.05 μ m Rz, Rmax: 160 μ m/0.05 μ m	Good New	JIS			
8.	Precision Thermometer Calibrator		1991	JAPAN	Thermocouple/mV and Ohm Measurement, mV Calibration	Good New	ITS 90	1 year		
9.	Digital Multimeter		1992	JAPAN	AC and DC Voltage, R, AC and DC Current Measurement	Good New		1 year		
10.	Lathe Machine	1	January, 1992	Austria		Good New	ISO	1 year		
11.	Lathe Machine	1	1992	Swiss	Longitudinal Stroke: 60 mm Transverse Stroke: 65 mm Accuracy Reading: 0.01 mm	Good New	ISO	1 year		
12.	Digital Power Factor Meter	1	1994	JAPAN	Effective Measurement Range: 30% to 120% of input (V and A) 50% to 120% of rate value VA	Good New				
13.	Dynamic Strain Amplifier	1	1994	JAPAN	Gauge Resistance: 60 - 1,000 ohm Gauge Factor: 2.0	Good New				

7. Name of Facilities and Equipments for the Testing of Metal Working (2/3)

Item	Name	Q'ty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
							Method	Freq.	Method	Freq.
14.	Foil Strain Gauge	55	1994	JAPAN	Gauge Factor: 2.1 Gauge Length: 2 mm and 10 mm	Good New				
15.	Precision Load Cell	1	1994	JAPAN	Rate Capacities: 2, 5, 10, 20 and 50 (#) Safe Overload: 150 % F.S. Non Linearity: 0.2 % F.S. Hysteresis: 0.2 % F.S. Repeatability: 0.1 % F.S.	Good New				
16.	Torque Transducer	1	1994	JAPAN	Rated Capacities and Max rpm: 20 kgm/7,500 rpm Non Linearity: 0.3 % R.O. Repeatability: 0.3 % R.O.	Good New				
17.	Hack Saw Machine	1	1992	Taiwan	Model: 16" Max. Cutting Capacity: 165 mm x 165 mm Saw Blade Size: 400 x 25 x 1.25 mm Swivel Angel: 45 75 mm Cutting Speed: 90 rpm/100 rpm, 2 speed	Good New				
18.	Shock Pulse Measurement	1	1981	Sweden		Good				
19.	Extensor Meter	1	June, 1994	JAPAN		Good New				
20.	Load Cell	1	1994	JAPAN		Good New				
21.	Ultrasonic Flaw Detector	1	1992	JAPAN	Test Range: 10 - 10,000 mm For steel and nonferrous metal	Good New				
22.	Ultrasonic Thickness Meter	1	1994	U.K.	Measure Thickness of Steel through Surface Coating: Freq.: 3 MHz Accuracy: 1% = 1 digit	Good New				
23.	Thickness Tester for Coating	1	1994	U.K.	For Nonferrous Metal: Range: 0 - 1,000 μm	Good New				

7. Name of Facilities and Equipments for the Testing of Metal Working (3/3)

Item	Name	Qty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
							Method	Freq.	Method	Freq.
24.	Thickness Tester for Coating	1	1994	U.K.	For Ferrous Metal: Range: 0 - 1,200 μ m	Good New				
25.	Eddy Current Motor	1	1994	Taiwan	Power: 20 Hp Max. Output Torque: 9.6 kgm Speed Control 120 - 1,200 rpm	Good New				
26.	Rockwell Hardness Tester	3		JAPAN		Good	JIS	1 year		
27.	Shore Hardness Tester	1		JAPAN		Good New	JIS	1 year		
28.	Brinell Hardness Tester	2		Swiss		Good	JIS	1 year		
29.	Tensile Testing Machine	1		R.D.G.		Good	ISO	1 year		
30.	Impact Testing Machine	1		R.D.G.		Good				
31.	Rotary Bending Fatigue	1		JAPAN	Max. Bending Moment: 30 kgm	Good New				
32.	Vibro Meter	1	1980	Sweden		Good				

Chart A2-8 Organizational Structure of BBK

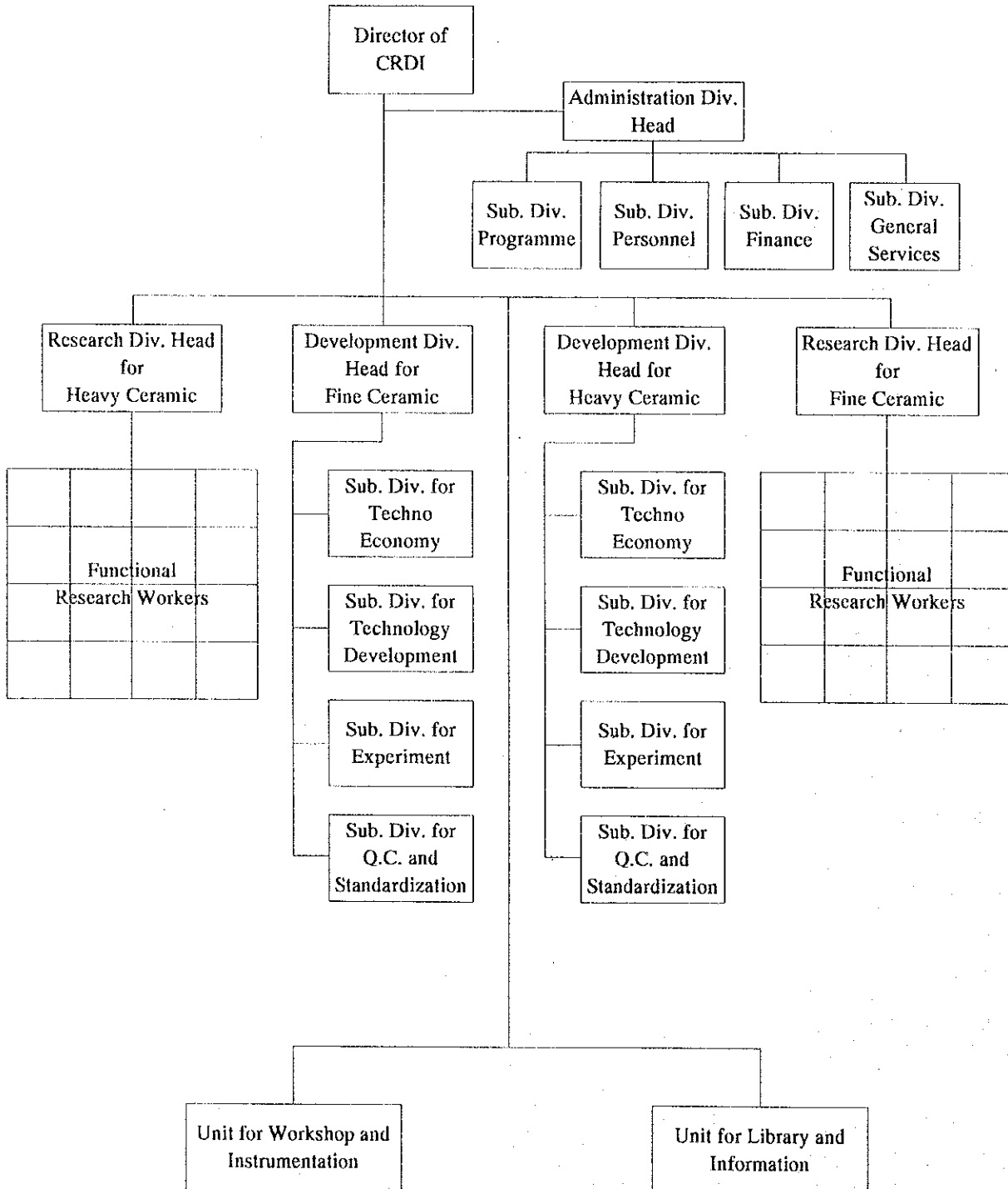


Chart A2-9 Testing/Inspection Items, Number of Staffs and Number of Test in BBK

Field	Testing Item	No. of Staffs (1993)	Number of Testing/Inspection				
			1989	1990	1991	1992	1993
Raw Material	Raw material	15	324	314	638	371	379
Glass & Enamel Product	- Float glass, bottle, safety glass, tableware, vial glass, enameled bath, enameled water pump	10	41	63	49	25	103
Fine Ceramic Products	- Insulators, tableware, wall tile, floor tile, sanitary wares	8	44	24	56	68	80
Heavy Ceramic Product	- Building brick, re-factory, lime, concrete, roof tile	6	55	34	61	62	32
Other Product	- Waste, ash, coal, ceramic filter, laboratory glass, opal glass	-	5	8		58	41
Total		39	469	443	804	584	635

Chart A2-10 Budget of BBK (1089/90-193/94)

Year	Budget ('000 Rp)
1989/1990	696,507
1990/1991	797,282
1991/1992	1,003,813
1992/1993	1,159,324
1993/1994	1,438,642

Chart A2-11 Revenue of Institute from the Handling Fees for Testing and Calibration Services

No.	Field	Handling Fee (Rp)				
		1989	1990	1991	1992	1993
1.	Research Division for Fine Ceramic, Glass and Enamel	1,658,850	407,150	2,083,600	4,689,800	20,239,500
2.	Research Division for Heavy Ceramic	2,303,825	1,125,100	6,366,150	8,509,430	9,185,200
3.	Development Division for Fine Ceramic	2,685,950	355,300	5,968,350	3,896,920	11,126,146
4.	Development Division for Heavy Ceramic	1,465,275	608,700	2,816,700	4,384,750	3,611,000

Chart A2-12 Name of Facilities and Equipments (1/6)

No.	Item	Name	Q'ty	Production Date	Origin	Specification	Working Condition		Calibration		Maintenance	
							Condition	Method	Frequency	Method	Frequency	
I. Chemical Analysis												
1.	AAS		1	82	Holland	Pye Unicam Sp. 9 /Philips	Good	Routine Check Compared with Standard	12/year	Cleaning	Before using	
2.	Spectro Plus		1	77	England	NSE Spectro Plus	Good	Routine Check Compared with Standard	12/year	Cleaning	Before using	
3.	Flame Photometer		2	84	England	Corning 400	Good	Routine Check Compared with Standard	12/year	Cleaning	Before using	
4.	X-Ray Fluorescence Spectrometry		1	80	Holland	Philips P.V. 1410	Good	Routine Check Compared with Standard	12/year	Cleaning	Before using	
5.	PH. Meter		2	81	Holland	Pye Unicam	Good	Routine Check Compared with Buffer Standard	12/year	Cleaning	Before using	
6.	Colorimeter		1	78	Japan	ERMA AE 11	Good	Routine Check Compared with Standard	12/year	Cleaning	Before using	
7.	Analytical		8	74/84	West Germany	Sauter/Sartarins	Not working: 2	Intern Check with Standard	12/year	Cleaning, zero setting	Before using	
II. Micro Structure Instrument												
1.	X-Ray Diffraction		1	78	Holland	Philips PV. 1130/00	Good	Goniometer Extern Check	2/year	Cleaning	Before using	
2.	SEM		1	82	Holland	Philips 505	Good	Accuracy of Magnification Scale (extern)	2/year	Cleaning	Before using	
3.	JR Spectrophotometer		1	83	Holland	Philips/Pye Unicam SP. 3-300	Good	Routine Check Compared with Standard	12/year	Cleaning	Before using	

Chart A2-12 Name of Facilities and Equipments (2/6)

No.	Item	Name	Qty	Production Date	Origin	Specification	Working Condition	Calibration			Maintenance		
								Method	Frequency	Method	Frequency	Method	Frequency
III.	Thermal Testing	1. Calorimeter	2	74	Holland	Callencamp. Cat. No. CB. 110 App. No.: 14 CB. 110	Good	Thermometer Extern Check	1/year	Cleaning	Before using		
		2. Thermal Conductivity Tester	1	80	Kyoto Electrical (Japan)	TC. 31 KARER	Good	Digital Temperature System Check (extern)	1/year	Cleaning	Before using		
		3. Electrical Furnace	9	79	Germany	MABER LTB (1600°C)	Not Working:	7 Trayek Temperature Firing Check	1/year	Cleaning	Before using		
		4. Drying Furnace	7	79/75	West Germany	1. Hammer 2. Gallenkamp. Model in Holland Qal. 744 FD 1500°C 3. Salvis in Ventur No. 321035/004 4. Qal. 325 GH	Not Working:	2 Trayek Temperature Firing Check	1/year	Cleaning	Before using		
		5. Dilatometer	2	75	Germany	METZTSCH Max. 1400°C	Good	Dial Temperature Check	1/year	Cleaning	Before using		
		6. Heating Microscope	1	78	Germany	I&ITZ. 301-200. 501	Good	Gradient Temperature Check	1/year	Cleaning	Before using		
		7. Gradient Temperature Furnace (GTF)	1	83	USA	Harrop Model GTF 30-MD	Good	Gradient Temperature Check	1/year	Cleaning	Before using		

Chart A2-12 Name of Facilities and Equipments (3/6)

No.	Item	Name	Q'ty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
								Method	Frequency	Method	Frequency
III. Thermal Testing											
	8.	PCR Tester	1	78	USA	Bickley Model 1800 B	Good	Gradient Temperature Check & Flowmeter Check	1/year	Cleaning	Before using
	9.	Thermal Shock Tester	1	87	Japan	Fuji 100°C	Good	Dial Temperature Check	1/year	Cleaning	Before using
	10.	Softening Point Tester	1	73	USA	Harrop Lab. Modell Sp. IA	Good	Gradient Temperature Check	1/year	Cleaning	Before using
	11.	Annealing and Strain Point Tester	1	73	USA	Model Sp. 2A	Good	Gradient Temperature Check	1/year	Cleaning	Before using
	12.	BTA/TGA	1	73	Germany	WEITJ&R	Not Working	Gradient Temperature Check	1/year	Cleaning	Before using
IV. Optical Testing											
	1.	Polarisation Microscope	2	-	Austria	Reichert MR 245-791	Not Working	Routine Check	Before using	Cleaning	Before using
	2.	Gloss Meter	1	91	Japan	Minolta GM 060	Good	Routine Check Compared with Standard	1/year	Cleaning	Before using
	3.	Refractory Abbe	2	77/92	Germany	Carl Zeiss	Good	Routine Check Compared with Standard	1/year	Cleaning	Before using
	4.	Optical Distorsin Testing	1	79	Japan	Cabin Automat Rotary Cerie No. 193700780	Good	Routine Check Compared with Standard	1/year	Cleaning	Before using
	5.	Optical Devision Testing	1	79	-	Local	Good	Routine Check	1/year	Cleaning	Before using

Chart A2-12 Name of Facilities and Equipments (4/6)

No.	Item	Name	Qty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance		
								Method	Frequency	Method	Frequency	
IV. Optical Testing												
	6.	Transmision Tester	1	-	Holland	Vitatron	Good	Routine Check Compared with Standard	Before using	Cleaning	Before using	
	7.	Haze Meter	1	87	Japan	Suga test instrument Type BGM/3 RP No. CH 287104	Good	Digital Transmission Check	1/year	Cleaning	Before using	
	8.	Polari Meter	1	77	England	B. GIRA	Good	Routine Check Compared with Stain Disc Standard	Before using	Cleaning	Before using	
9. Shade Band Comparative Testing												
			1	87	Japan	Shade Band & Color	Good	Routine Check Compared with Color Standard	1/year	Cleaning	Before using	
V. Mechanical Testing												
	1.	Universal Testing Machine	2	74/83	Germany	Hohr & Federbass A.G	Good	Nanoter Check	1/year	Cleaning	Before using	
	2.	Banding Stength Tester	1	76	Germany	Meizch max 60 kg	Not Working:	1 Nanoter Check	1/year	Cleaning	Before using	
	3.	Inpact Strength Tester	3	52	Japan/Germany	Tachikawa-Ton Industrie	Good	Weight Check	1/year	Cleaning	Before using	
	4.	Bag Impaction Tester	1	82	Local	Tachikawa-Ton Industrie	Good	Weight Check	1/year	Cleaning	Before using	
	5.	Increment Presure Tester	1	76	USA	Butler PA 1802	Not Working:	1 Pressure Check	1/year	Cleaning	Before using	
VI. Physical Testing												
	1.	Viscometer	1	84	England	Say Bott	Good	Viscosity Check	1/year	Cleaning	Before using	
	2.	Autoclave	3	81-83	Germany -England	Ton Industri-Farnell	Good	Nanometer Check	1/year	Cleaning	Before using	
	3.	Density Comparator	1	72	USA	AGR	Good	Viscosity and Temperature Check	1/year	Cleaning	Before using	

Chart A2-12 Name of Facilities and Equipments (5/6)

No.	Item	Name	Q'ty	Production Date	Origin	Specification	Working Condition		Calibration		Maintenance	
							Condition	Method	Frequency	Method	Frequency	
VI.	Physical Testing											
4.	Radiation UV Tester		1	87	Japan	Type MLG-1, No inf 487104 Suga Test Instruments Co. LTD	Good	Intensity UV Ray & Temp Check	1/year	Cleaning	Before using	
5.	Abrasion Tester		7	87-87	Italy-USA	PEI Method-Teledyne Taber	Not Working: 2	Rotation, Hardness & Weight Check	1/year	Cleaning	Before using	
6.	Ultra-X		1	80	Germany	Mur Siebering MR 5607	Good	Moisture Scale Check	1/year	Cleaning	Before using	
7.	Sedimentation Balance		1	79	Germany	Sartorius Type 4610 MR 280. 7009	Good	Weight Tester	1/year	Cleaning	Before using	
8.	Binocular Microscope		2	-	Germany	Zeiss 4750-22	Good	Routine Check	Before using	Cleaning	Before using	
9.	Mob's Scale		2	-	Germany	Ton Industrie-Berlin Fste Deman	Not Working: 2	-	-	Cleaning	Before using	
10.	Sieve Shaker		5	78	Germany	Cenco-Neinter Catalog 18480	Good	Speed Check	1/year	Cleaning	Before using	
11.	Vicat		2	-	India	-	Not Working: 1	-	Before using	Cleaning	Before using	
12.	Plasticity Meter		5	79	England	ELE	Not Working: 2	-	-	Cleaning	Before using	
13.	Whitniss Tester		1	85	Japan	Kaett Electric Lab Model C. 100	Good	Routine Check Compared with Standard	1/year	Cleaning	Before using	
14.	Blaine		2	82	Germany	Toni Technic	Not Working: 2	Material Standard Check	Before using	Cleaning	Before using	
15.	Climax Box		2	-	USA	Fison Type 280	Not Working: 1	Material Standard Check	Before using	Cleaning	Before using	
16.	Flow Table		1	82	USA	Bumbolot-MTD 06	Good	-	-	Cleaning	Before using	

Chart A2-12 Name of Facilities and Equipments (6/6)

No.	Item	Name	Q'ty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
								Method	Frequency	Method	Frequency
VI.	Physical Testing	17. Gas Detector	2	75-85	Japan-Holland	Kitagawa Model 400/Galencamp Serie 414	Not Working: 1	Routine Check	1/year	Cleaning	Before using
		18. Length Comparator	2	82-84	Japan	Tani Fuji	Good	Scale Check	1/year	Cleaning	Before using
		19. Water Betention Tester	1	84	USA	Bumboldt-MF 6	Good	-	1/year	Cleaning	Before using
		20. Absorption Capacity Tester	1	57	Germany	Ton Industrie Max 400kg/cm	Good	Dial Pressure Tester	1/year	Cleaning	Before using
		21. Tile Tester	2	75	Local	Local 20 cm x 20	Good	Dial Gauge Test	1/year	Cleaning	Before using
		22. Dimension Glass Tester	5	77	Holland	Completed with Dyle Micro Meter	Good	Dial Gauge Test	1/year	Cleaning	Before using
		23. Dielectric Strength Tester	1	-	Japan	Rikosha 0-58 kv	Good	Voltage Check	1/year	Cleaning	Before using

Chart A2-13 Testing/Inspection Institutes for Building Materials in Jakarta

No.	Institutes	Address	Testing/Inspection Items
1	P.T. Soil & Foundation	JL. Pakubuwono IV No. 6A TEL: 710324	1) Site Investigation 2) Soil & Concrete Testing
2	P.T. Geonorma Utama	JL. Ligamas Indah Blok E IV No. 1 TEL: 791509	1) Site Investigation 2) Soil Testing 3) Foundation Engineering 4) Topographic
3	P.T. Soilens	JL. Wahid Hasym No. 42 TEL: 332049-323927	1) Site Investigation 2) Soil Mechanic 3) Foundation Geotechnic 4) Construction & Quality Control 5) Topographic Survey and Mapping
4	Wiratman & Ass.	JL. Bendungan Hilir Raya Kav. 36A, Blok B No. 14-18 TEL: 583407	1) Geotechnical Investigation 2) Laboratory Testing 3) Survey & Mapping 4) Mineral Investigation
5	P.T. Radiant Utama	JL. Gandaria I Persil 3 Kebayoran Baru	1) Welder Test 2) Ultrasonic Test 3) Radiographic Test 4) Penetrant Test
6	P.T. Sucofindo	JL. Letjen S. Parman 102	1) Geotechnic Test 2) Petrochemical Test 3) Welding Test
7	Lembaga Uji Konstruksi Puspitek-Serpong	Serpong	1) Building Material Test 2) Device Test
8	Badan Penelitian Bahan Industry	JL. Sangkuriang 50 Bandung	1) Building Material Test 2) Device Test
9	Universtas Bahan	JL. Kyai. Tapa TEL: 59338	1) Soil Test 2) Concrete Test
10	Universitas Indonesia, Fakultas Teknik (Lembaga Teknologi)	JL. Salemba 4	1) Soil Test 2) Concrete Test
11	P.T. Indah Karya	JL. Kemang Raya 125 A TEL: 790234-790848	1) Survey & Mapping 2) Soil Test 3) Material Test 4) Quality Control
12	Balai Penelitian Bahan	JL. Letjen Suprpto No. 42 TEL: 412179	1) Building Material Test 2) Quality Control
13	Construction Guidance Service Center	JL. Raya by Pass Bekasi	1) Concrete Test 2) Soil Test

Chart A2-14 Organizational Chart of IRDCI

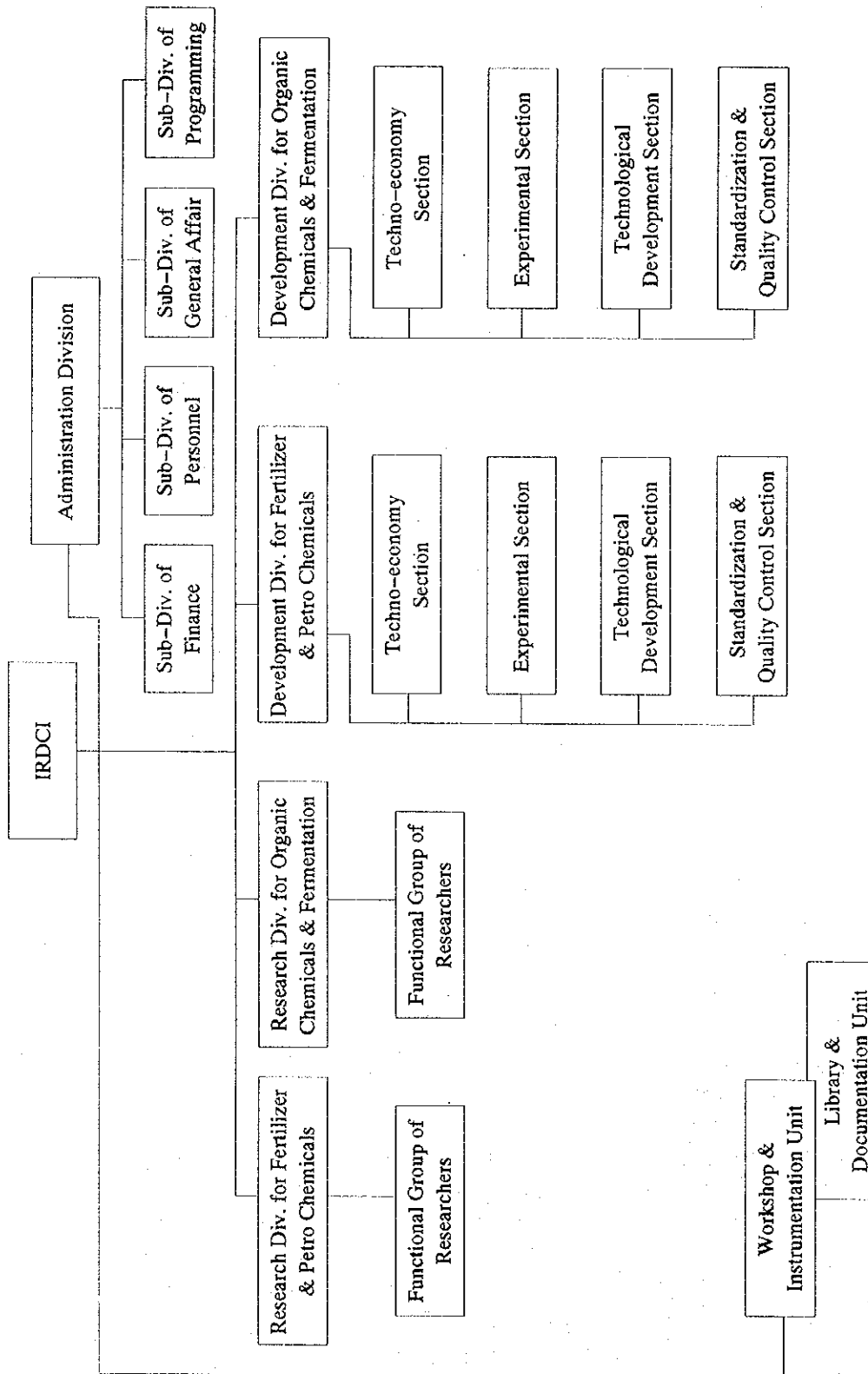


Chart A2-15 List of Equipment Existing at the IRDCI (1/2)

	Name of Equipment	Number	Date of Procurement
Pesticide Laboratory	1. High Performance	1	1983
	2. Gas Chromatography	1	1986
	3. Karl Fisher Manual Titrator	1	1986
	4. Mortar Grinder	1	1985
	5. General Purpose Mill	1	1985
	6. Sample Mill	1	1985
	7. Rotary Evaporator	1	1985
Pollution Laboratory	1. Atomic Absorption Spectrophotometer	1	1984
	2. High Volume Sampler	1	1983
	3. Gas Sampler	1	1983
	4. Water Quality Checker	1	1983
	5. Sound Level Meter	1	1983
	6. Vibration Meter	1	1983
	7. Anemometer	1	1983
	8. Water Test Kit	1	1983
Development Division for Fertilizer and Petrochemical	1. Parallel Plate Plastometer	1	1985
	2. Clark Type Softness Tester	1	
	3. Izod Type Impact Tester	1	1984
	4. Falling Dart Impact Tester	1	1985
	5. Friction Angle Tester	1	1985
	6. Micro Melt Indexer	1	1984
	7. Plastic Cutting Instruments	1	1985
	8. Hardness Tester Type Rock Well	1	1985
	9. Haze Meter	1	1985
	10. Color and Color Difference Meter 1001 DP	1	1985
	11. Duro Meter	1	1985
	12. Auto Strain No. 216	1	1985
	13. Density G Radienc Column System	1	1984
	14. Small Test Press	1	1985
	15. Calori Meter	1	1985
	16. Gas Chromatograph P.U. 4500, Philips	1	1983
	17. Philips UV/VIS Spectrophotometer, SP-400	1	1983
	18. SP3-300A Infra Red Spectrophotometer Philips	1	1983
	19. Fisher Electrophotometer II Double Beam Calorimete	1	1984
	20. Karl Fisher	1	1985
Development Division for Organic Chemicals & Fermentation	1. Incubator	1	1975
	2. Handy Clave	1	1975
	3. Microscope	2	1975
	4. Colony Counter	1	1975
	5. UV Spectrophotometer	1	1975
	6. Polarimeter	2	1975
	7. Viscosimeter	1	1975
	8. Refractometer	1	1975
	9. Electronic Photofluorometer	1	1975

Chart A2-15 List of Equipment Existing at the IRDCI (2/2)

	Name of Equipment	Q'ty	Date of Procurement
Testing	1. Manometer Gauge	7	1992
	2. Digital Multimeter	1	1992
	3. Portable Ultrasonic Detector	1	1992
	4. Shore Hardness Tester	1	1992
	5. Rockwell Hardness Tester	1	1992
	6. Portable Hardness Tester	1	1992
	7. Precision Thermometer Calibration	1	1992
	8. Surface Roughness Tester	1	1992
	9. Rotary Bending Fatigue	1	1992
	10. Charpy Impact Tester	1	1992
	11. Universal Testing Machine	1	1992

Chart A2-16 Organizational Chart of PPMB

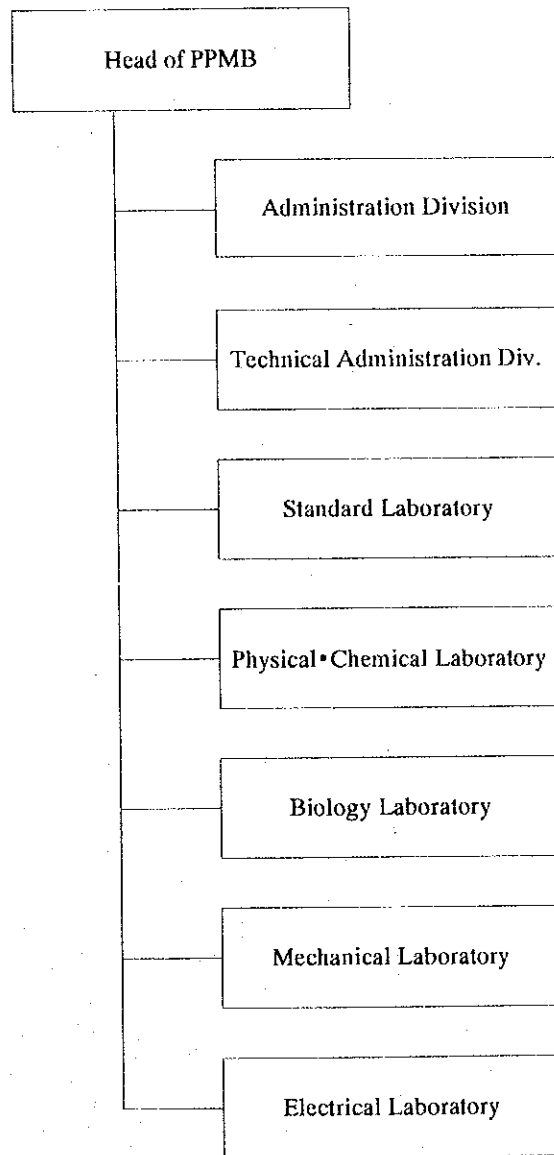
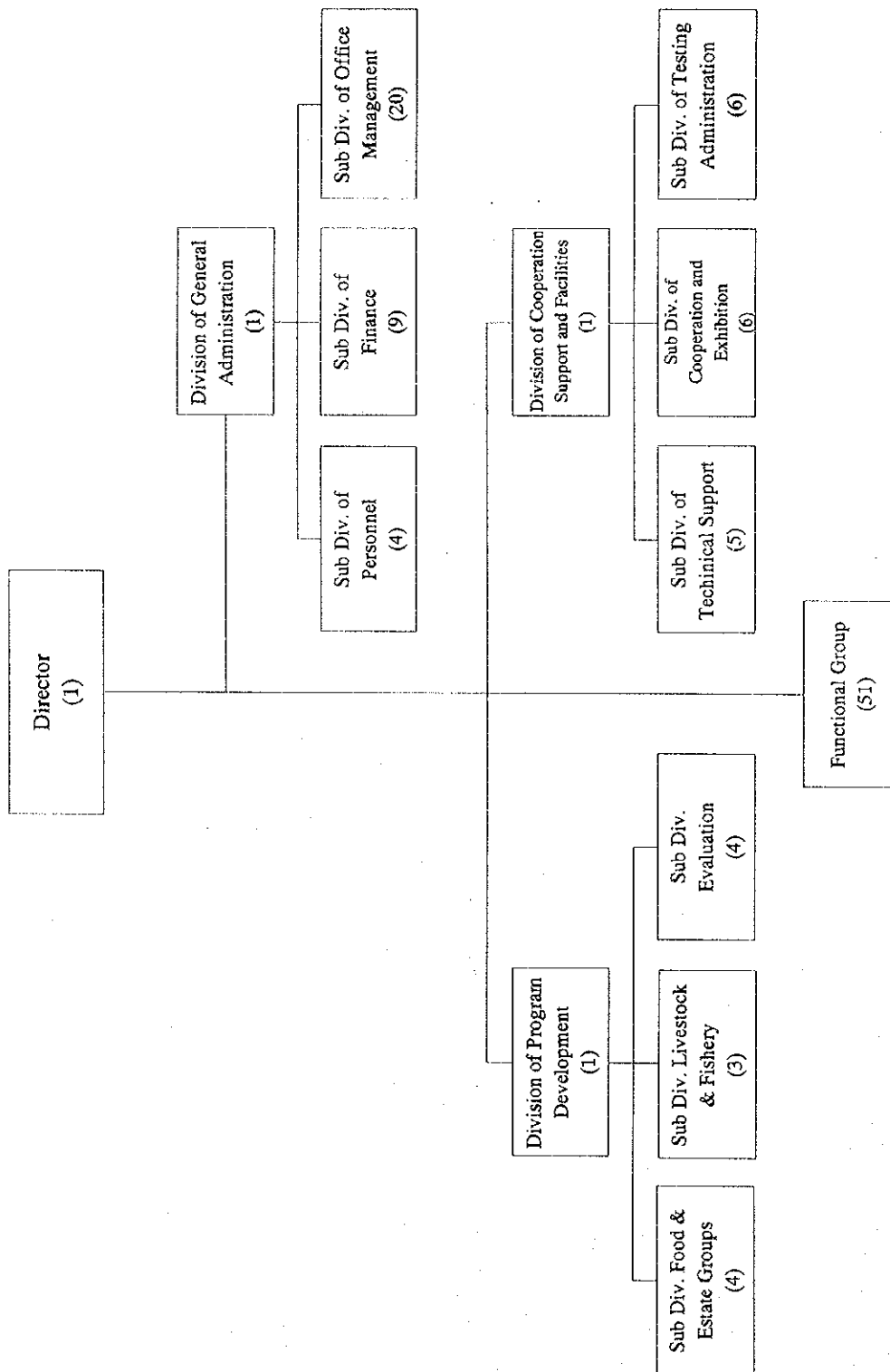


Chart A2-17 Organizational and Staffing of the Center for Development of Agricultural Engineering



Note: Figures in parenthesis show the number of staff in each divisions, sub-divisions.

Chart A2-18 Number of Testing and Inspection

Field	Testing Item	Number of Testing and Inspection	
		1993	1994
1. Hand Tractor	Field and Laboratory Performance Test	7	9
2. Four Wheel Tractor	Field and Laboratory Performance Test	-	3
3. Rice Milling Unit	Field Performance Test	1	2
4. Thresher	Field Performance Test	-	3
5. Pump	Field Performance Test	-	2

Chart A2-19 Name of Facilities and Equipments, BBP ALSINTAN (1/3)

No.	Item	Name	Qty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
								Method	Frequency	Method	Frequency
I.	Axle Dynamometer PSW210, PAD 402	1. Compressor 50 lt. 11kg/cm ²	1		Japan		Good				
		2. Pressure Gauge (0-300cc) GN3000	1		Japan		Good				
		3. Digital Tachometer	3		Japan		Good				
		4. Digital Multi Channel Temperature Recorder	1		Japan		Good				
		5. Fuel Flow Meter (FP-0011, FP-0021, FP-0031, DF-313)	1		Japan		Good				
		6. Load Cell Lc-1 tonf	2		Japan		Good				
		7. Pen Recorder	1		Japan		Good				
		8. Load Cell 2 tonf	2		Japan		Good				
		9. Disk Brake	1		Japan		Good				
		10. Brake Shoes	1		Japan		Good				
		11. Thermo-couple	2 set		Japan		Good				
		12. Multipen Recorder	1		Japan		Good				
		13. Data Tape Recorder	1		Japan		Good				
II.	PTO Dynamometer FSW-1211	1. Compressor, kw. 220 V. 5kg/cm ²	1		Japan		Good				
		2. Load Cell. 1 ton. for PSW-1211	2		Japan		Good				
		3. Disk Brake	1		Japan		Good				
		4. Brake Shoes	2		Japan		Good				
III.	Drawbar Dynamometer	1. Dynamometer Car 30 HP	1		Japan		Good				
		2. Strain Gauge and Accessories	2 Box		Japan		Good				
		3. Case for Strain Meter	1		Japan		Good				
		4. Load Cell 2 tonf	3		Japan		Good				
		5. Cable for Strain Meter	1		Japan		Good				

Chart A2-19 Name of Facilities and Equipments, BBP ALSINTAN (2/3)

No.	Item	Name	Qty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
								Method	Frequency	Method	Frequency
IV. Pump Testing Facilities											
	4", 6", 8", 10"	1. Digital Tachometer DT-2058	1		Japan		Good				
		2. Pressure Gauge 100kg/cm ²	1		Japan		Good				
		3. Pressure Gauge (0-5kg/cm ²)	1		Japan		Good				
		4. Pressure Gauge (0-10kg/cm ²)	1		Japan		Good				
		5. Flow Meter 6"	1		Japan		Good				
		6. Flow Meter 8"	1		Japan		Good				
		7. Strain Amplifier	1		Japan		Good				
		8. Digital Multimeter	1		Japan		Good				
		9. Vacuum Gauge (0-1kg/cm ²)	3		Japan		Good				
		10. Variety Speed Electromotor	1		Japan		Good				
		11. Torque Pick-up Meter 20kgf	1		Japan		Good				
		12. Torque Pick-up Meter 10kgf	1		Japan		Good				
V. Ergonometer											
		1. Ergonometer & Recorder	1 set		Japan		Good				
		2. Douglass Back	2 set		Japan		Good				
		3. Heart Rate Analyzer	1 set		Japan		Good				
VI. Instrument for Post Harvest Technology											
		1. Termometer (1) 0-200 C	10		Japan		Good				
		2. Termometer (2) 0-100 C	10		Japan		Good				
		3. Termohidrometer	1		Japan		Good				
		4. Balance (1) Digital 0-600 gr	2		Japan		Good				
		5. Balance (2) Digital 0-1000 gr	1		Japan		Good				
		6. Measuring Cylinder (1) 500 cc	1		Japan		Good				
		7. Measuring Cylinder (2) 1000 cc	1		Japan		Good				
		8. Rubber Hardness Meter	1		Japan		Good				
		9. Culture Dish	15		Japan		Good				
		10. Magnifying Glass	2		Japan		Good				

Chart A2-19 Name of Facilities and Equipments, BBP ALSINTAN (3/3)

No.	Item	Name	Qty	Production Date	Origin	Specification	Working Condition	Calibration		Maintenance	
								Method	Frequency	Method	Frequency
VI. Instrument for Post Harvest Technology											
	11.	Spacement Bottle	25		Japan		Good				
	12.	Oven	3		Japan		Good				
	13.	Rice Milling Unit (Big & Min)	2		Japan		Good				
	14.	Polisher	2		Japan		Good				
	15.	Rice Grader	2		Japan		Good				
	16.	Winnower	2		Japan		Good				
	17.	Husker	2		Japan		Good				
	18.	Milling	2		Japan		Good				
	19.	Sample Divider	1		Japan		Good				
	20.	Rotary Dry Oven	1		Japan		Good				
	21.	Grain Moisture Tester	1		Japan		Good				
	22.	Whiteness Tester for Rice	2		Japan		Good				
VII. Sprayer Testing											
	1.	Loop and Pocket Microscope	1		Japan		Good				
	2.	Droplet Distribution Pattern	1		Japan		Good				
VIII. Supporting Instrument											
	1.	Cool Storage	2		Japan		Good				
	2.	Soil Penetrometer	1		Japan		Good				
	3.	Vibration Meter	1		Japan		Good				
	4.	Sound Level Meter	2		Japan		Good				
	5.	Soil Bean	1		Japan		Good				
	6.	Anemometer	1		Japan		Good				
	7.	Roll Meter	2		Japan		Good				

Chart A2-20 Number of Service LMK

NO.	Technical Service	Number of Services				
		88/89	89/90	90/91	91/92	92/93
1	Direct Application from PLN * (Commissioning tests, trouble shooting, etc.)	507	252	361	426	377
2	Internal Activities (including testing for LMK marks of Conformity)	77	40	34	3	9
3	Application from Companies for PLN needs (Type tests and acceptance tests to fulfill contract agreements for delivery of materials)	753	370	229	186	291
4	Application from Government (Testing for SII mark of Conformity)	106	23	25	45	46
5	Others (Type tests, commissioning tests, trouble shooting chemical analysis, Calibration and other test)	318	253	362	285	312
Total Application		1,761	938	1,011	945	1,035

Source: LMK-PLN

Note: *PLN Head office, PLN Region, PLN Project

Chart A2-21 Organizational Chart of PLN

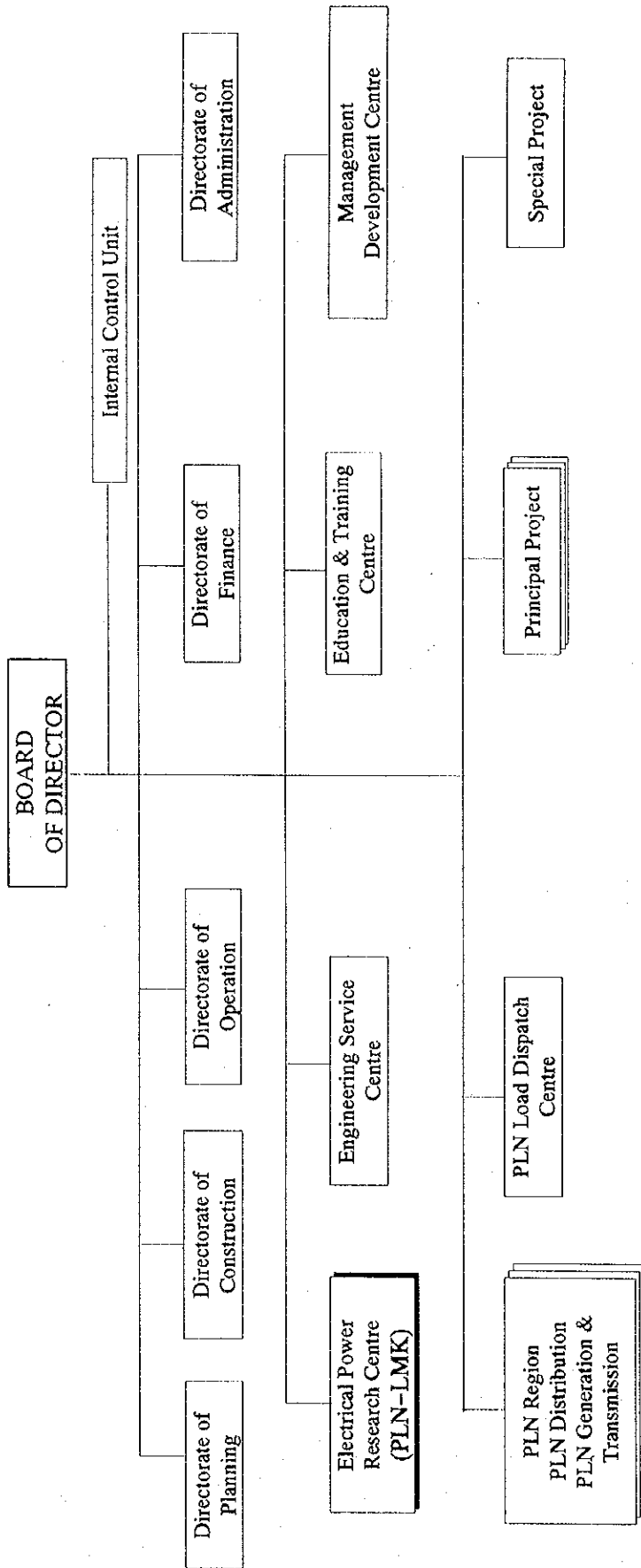


Chart A2-22 Organizational Chart of PLN-LMK

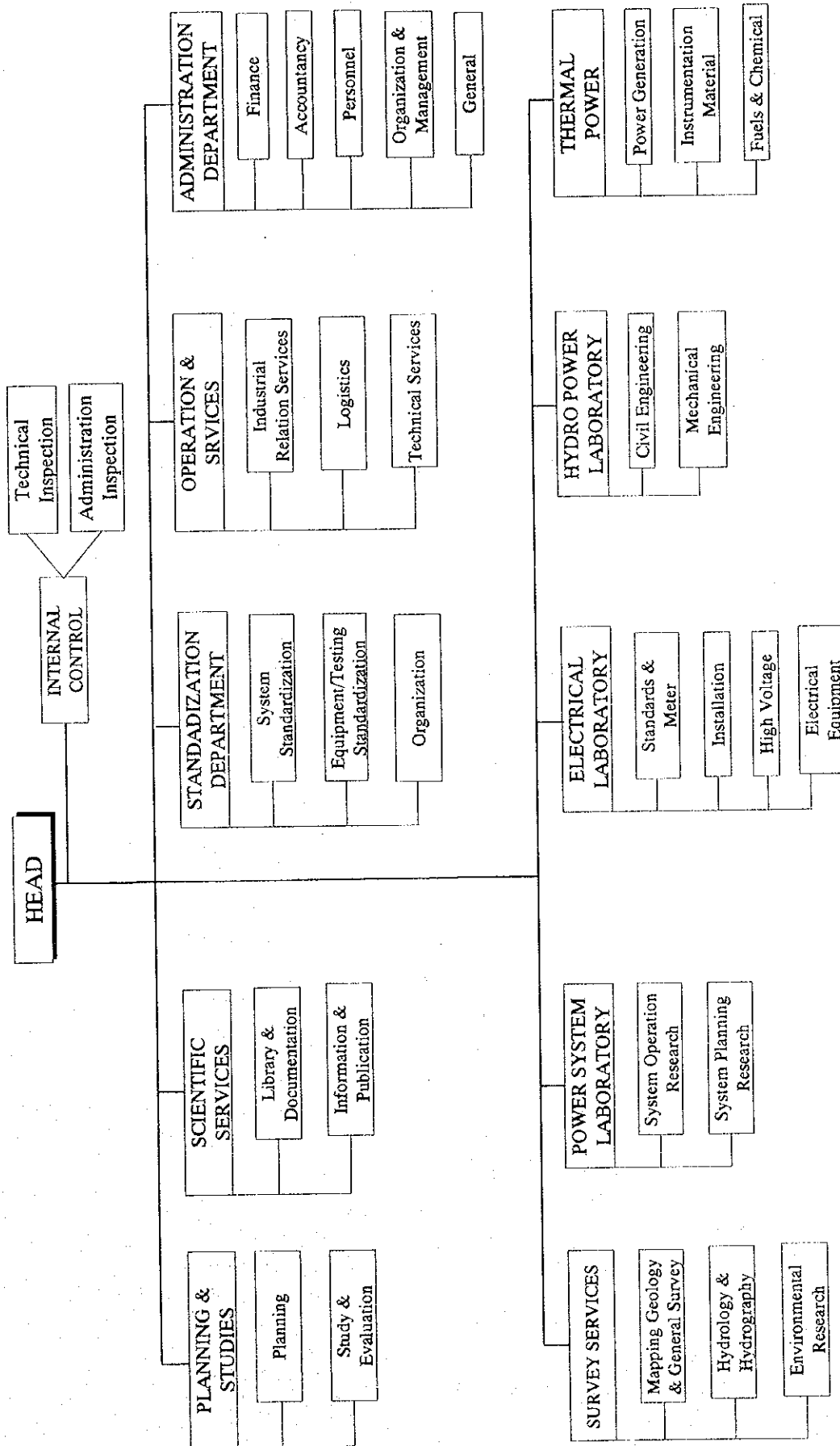


Chart A2-23 Outline of Laboratory

Department/Laboratory	Section	Sub-section
Electrical	Standards & Meter	Standard
		Electrical Calibration
	Installation	Electrical Measuring Equipment
		Photometry
High Voltage	Electric Power Installation	
	Telecommunication	
	Protective Relays Control	
Low Voltage Electrical Equipment	Lightning Research	
	High Voltage Research	
	High Voltage Equipment	
	Distribution Equipment	
	Cables	
	Switchgear	
	Household Appliances	
Hydro Power	Civil Engineering	Hydraulics
		Geotechnique
Hydrology		
	Mechanical Engineering	Hydrodynamics
		Turbine Models
		Construction
Thermal Power	Power Generator	Steam Turbines
		Diesel & Gasturbines
		Non-conventional
Instrumentation & Materials	Instrumentation & Control	Material Testing
		Vibration & Noise
		Chemical Analysis
Fuels & Chemical	Fuels	Materials
Survey	Mapping Geology & General Survey	General Survey
		Mapping Survey
		Geological Survey
Hydrology & Hydrography	Hydrological Survey	Hydrological Survey
		Hydrographic Survey
Environmental Research	System Operation Research	System Operation
		System Control
		System Protection
Power System Research	System Planning Research	System Planning
		System Reliability
		Computer Services

Chart A2-24 List of Installation Material In Type Test

NO.	Installation Material	Range
1	L.V. Cable for fix installation	1.5 - 500 mm ²
2	Cord and flexible cables	0.5 - 120 mm ²
3	Overhead Cables	1.5 - 70 mm ²
4	M.V. Cable	16 - 400 mm ²
5	Cable Accessories	various size
6	Bare Conductors	16 - 1000 mm ²
7	Lighting Conductor	16 - 300 mm ²
8	Ground Rod	12.5 - 25 mm ²
9	Fuse Box	up to 500 V - 1000 A
10	L.V. Switch Board	up to 500V - 25A
11	MCB	230/415 V up to 1000V
12	ELCB	up to 500V - 63A
13	Fuse (NH-fuse)	380/415 V up to 100 A
14	Customer's Meter Board	1 phase, 3 phase
15	Switch	up to 500 V - 25 A
16	Time Switch	up to 250/440 V - 63 A
17	Contractors	up to 660 V - 63 A
18	Plug	up to 500 V - 25 A
19	Socket Outlet	up to 500 V - 25 A
20	Steel Conduit	up to 3/4"
21	PVC Conduit	up to 50 mm
22	Flexible Conduit	up to 1.5"
23	Block Terminal	up to 1000 V - 35 mm ²
24	Connector	up to 35 mm ²
25	Small Transformer	220/380 V, 1 phase, up to 50KVA
26	Incadecent Lamp	220/240 V up to 300 Watt
27	Fluorcent Lamp	up to 220 V - 60 Watt
28	Starter	up to 65 Watt
29	Ballast	up to 1000 V
30	Lamp Holder	up to 250 - 300 W
31	Capasitors	250 V
32	Steel Lamp Amature	up to 1000 V - 400 W
33	Insulator	LV, MV
34	Digital Meter	Class 0.02
35	Energimeters	Class 0.2 - 2.5
36	Instrument Transformer	Class 0.1
37	Other Electrical Accessories for Electrical Installation	various size

Source: LMK-PLN

Chart A2-25 Number of Clients by Service

NO.	Kinds of Services	Number of Clients
1	Type tests of various Electrical Accessories	27
2	Type tests of Energy Meters	17
3	Type tests of Concrete and Steel Poles	16
4	Type tests/acceptance tests of Cable Terminals	15
5	Type test of Insulator	12
6	Type test of Bare Conductor	9
7	Type test of M.V. Metal Enclosed Switchgear and Controlgear	7
8	Type tests/type analysis of Transformers (distribution Transformer, Power Transformer, others)	7
9	Type test of 20KV Jointing and Termination	7
10	Type test and acceptance test of L.V. Switchgear and Controlgear	6
11	Type tests of Ground Rod	6
12	Type tests of Disconnecting/Isolating Switch	3
13	Type tests of Load Break Switch	3
14	Type tests of Consumers Meter Board	3
15	Type test of MCB	3
16	Type tests of Flexible Cable	3
17	Type tests of Lighting Arrester	2
18	Type tests of Fuse Cut Out	1
19	Type tests of galvanized Steel Wire Stand	1
20	Type tests of Distance Relays	1
21	Type tests of galvanized pipe	1
22	Type tests of Capacitor	1
23	Calibration various measuring instruments (H.V. test set, kelvin bridge, double bridge thermometer, pressure gauge 1 and 3 phase energy meter, digital multicap and insulation tester, gaivanometer, flowmeter)	17
24	L.V. Cable	22
25	M.V. Cable	6
26	Tests/analysis of transformer Oil	28
27	Tests/ analysis of water	1
	Total	225

Note: Number of non PLN clients in testing and calibration of equipment and materials in 1992/1993.

Source: LMK-PLN

Chart A2-26 Organizational Chart of BPBJ

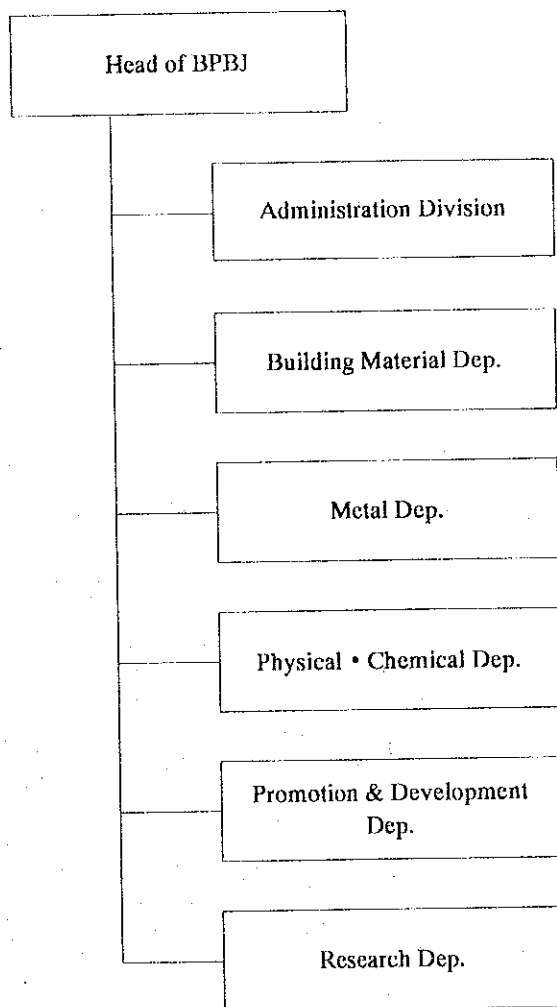


Chart A2-27 Number of Measurement Services of BPBJ during past 5 years

Materials	Items	1989	1990	1991	1992	1993
Metal	Concrete Steel Bar	17	53	101	407	695
	Others	68	56	27	67	26
	Sub Total	85	109	128	474	721
Non Metal	Asbestos	26	49	20	55	27
	Floor Brick	9	17	21	19	18
	Roof Tile	16	9	19	15	17
	Others	41	54	82	51	31
	Sub Total	92	129	142	140	93
Chemical	Paint for Wall/Wood	6	45	-	2	-
Grand Total		183	283	270	616	814

Chart A2-28 Budget and Revenue of BPBJ during past 5 years

(Unit: '000 Rp)

	Items	1989	1990	1991	1992	1993
Government Budget	General Budget	900	900	900	900	900
	Development	14,400	15,500	22,500	20,500	27,500
	Total	15,300	16,400	23,400	21,400	28,400
Revenue	Metal	96	140	157	409	679
	Non Metal	165	201	207	229	186
	Inspection	8	57	0	3	0
	Total	269	398	364	641	865

Chart A2-29 List of Equipment Existing at the BPBJ

List of Facilities and Equipments

- Universal Testing Machine, Cap 25 tons, 90 tons and 180 tons
 - Hardness Tester Machine, Cap 15, 30, 45, 60, 100, 120, 150, 187.5, 250 kgf
 - Impact Testing Machine (Charpny), Cap 150 and 300 J
 - Digital Micro Hardness Tester, Cap 10-1000 grf
 - Impact Testing Machine for Izod, Cap 30 pounds
 - Impact Testing Machine for PVC pipe
 - Water Pressure Machine for PVC pipe
 - Cutter Culler Machine for Metals, with Recirculating System
 - Welding Cutter Machine for Metals
 - Wrapping Test Machine for Wire
 - Any Kind of Work Shop Machine
 - For Example
 - Cutter Grinding Machine
 - Scrap Machine
 - Hack Saw Machine
 - Lathe Machine
 - Universal Milling Machine
 - Drilling Machine, etc.
 - Any Kind of Compressor
 - Universal Testing Machine, Cap 4 ton, 8 ton, 20 ton, 40 ton
 - Flexure/Bending Test Machine, Cap 200-1000 kgf
 - Flexure/Bending Test Machine, Cap 2000-6000 kgf
 - Hammer Test Machine for Concrete, Cap 3 ton
 - Sieve for Fine Aggregate
 - Sieve for Coarse Aggregate
 - Impermeability Test Machine for Concrete
 - Los Angeles Test Machine for Stone
 - Abrasive Test Machine for Tile, Marble, and Ceramics Tiles
 - Any Kind of Oven
 - Any Kind of Furnace
 - Any Kind of Balance
 - Any Kind of Measuring Tools Meter
 - Flame Rhots Meter
 - Photo Volt Reflection Meter
 - Electro Photo Meter Colorimeter
 - Ultra X Moisture Tester Digital
 - Dimitron for Paint Coating Meter
 - Thickness Meter for
 - Any Kind of Books Standard and Technology
-

Chart A2-30 Organizational Chart of Sucofindo

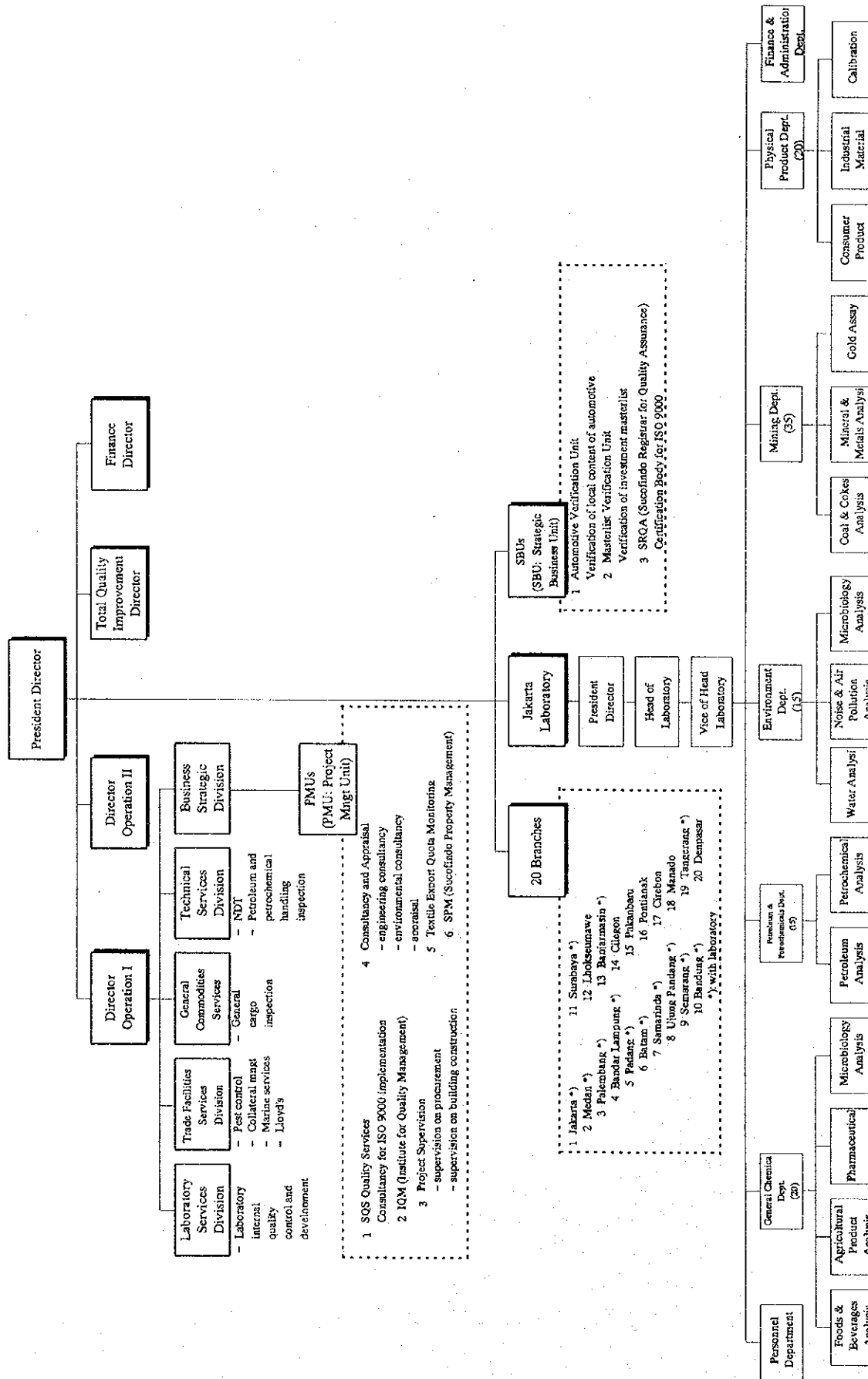


Chart A2-31 Trend of Revenue of Sucofindo during past 4 years

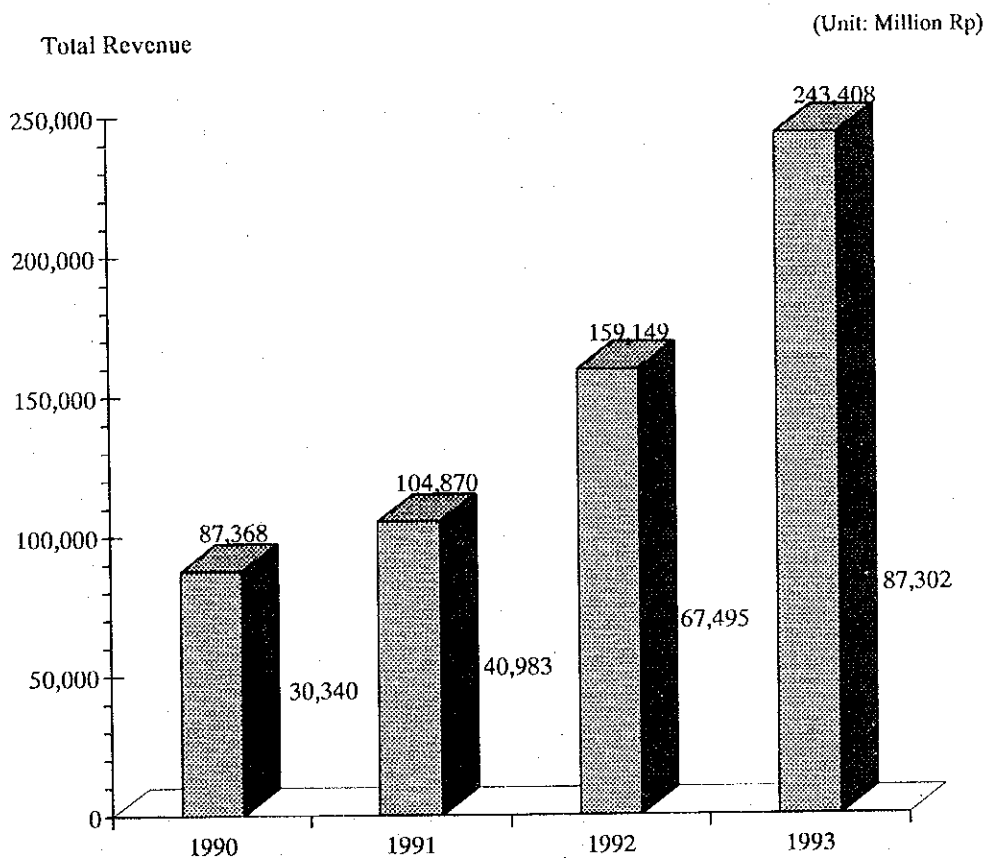


Chart A2-32 Sucofindo Laboratory Service Network

No	Branch Office	Laboratory Service				
		General Analysis	Minerals & Mining	Environmental	Petroleum & Petrochemical	Physical Testing
1	JAKARTA	○	○	○	○	○
2	MEDAN	○	○	○		
3	SEMARANG	○	○	○		
4	SURABAYA	○	○	○		
5	B. LAMPUNG	○				
6	U. PANDANG	○				
7	BANDUNG	○		○		
8	PLB/BKL	○	○			
9	PADANG		○			
10	SAMARINDA		○	○		
11	TG. BARA		○	○	○	
12	BANJARMASIN		○			
13	BATAM			○	○	

Appendix A2-1 Calibration Report of B4T



DEPARTMENT OF INDUSTRY
AGENCY FOR INDUSTRIAL RESEARCH AND DEVELOPMENT
**INSTITUTE FOR RESEARCH AND DEVELOPMENT OF
MATERIAL AND TECHNICAL PRODUCT INDUSTRIES**
14, Sangkuriang, Bandung 40135, West Java, Indonesia
Phone : (022) 2502027 - 2504828, Fax. : (022) 2502027, PO Box 32, Telex : 28276 PH IA

JNK
MEMBER NO. 10

CALIBRATION REPORT

Report No. : 3-01-94-5A Date April 8, 1994 Page : 1 of 5

Executed for : Cement Laboratory
Institute for R & D of Materials and Technical
Product Industries
14, Sangkuriang, Bandung

Received on : February 28, 1994

Equipment name : TEMPERATURE CONTROLLED
Type of Furnace : Air Recirculation, Model/Type : M-525,
Serial No. : 9354127, Maker : JN. NEY COMPANY,
Internal Dimension : 230 mm (H) x 155 mm (W) x 230 mm (D)

Calibration on : March 28, 1994 Recalibration on : March 28, 1995

Reference Standard : Australian Standard 2853 : 1986

Calibration apparatus used : Digital Thermometer No. 2190A,
Type K thermocouples.

This calibrator is certified traceable to : Instrument Calibration and Metrology Services, Instrument Services Section, Australian Defence Industries, and registered by the National Association of Testing Authorities, Australia. Certificate No. 31654

CALIBRATION RESULT : Enclosed

CONCLUSION :

Institute for R & D of Material
and Technical Products Industries
Director, Technical

Dr. MUH. SUBAGIO
NIP. 090010730

ATTENTION : A. This report not for publication and only for concerned samples.
B. This report shall not be reproduced except in full.

Appendix A2-2 Calibration Report of BBLM
Lembaga Ilmu Pengetahuan Indonesia
Pusat Penelitian dan Pengembangan Kalibrasi, Instrumentasi, dan Metrologi
Pengelola Teknis Ilmiah Standar Nasional untuk Satuan Ukuran

SERTIFIKAT KALIBRASI
CALIBRATION CERTIFICATE

IDENTITAS ALAT
Instrument Identification

Nama
Name
Merek Pabrik
Manufacturer
Tipe/ Nomor Seri
Type/ Serial Number
Lain-lain
Others

CALIBRATOR TESTER
MITUTOYO - JAPAN
170-102 / 90580
RANGE : 0 - 25 mm

Nomor Order :

E-930695

IDENTITAS PEMILIK
Owner Identification

Nama
Designation
Alamat
Address

Bagian Proyek Pengembangan Jaringan Kalibrasi
dan Pengujian - BBLM
BANDUNG

Perlu dikalibrasi ulang pada
Recommended date of recalibration

Sertifikat ini terdiri dari 3 halaman
This certificate includes pages

Diterbitkan tanggal 28 JULI 1994
Date of issue

Kepala Balai Penelitian
Sistem Kalibrasi dan Metrologi



SK. Komite Kalibrasi Indonesia No. KKI/01/1/79

Nomor Registrasi : JNK - 09/DIM/KE - DSN/1992; JNK - 09/SUHU/KE - DSN/1992; JNK - 09/KEL/KE - DSN/1992;
JNK - 09/GAYA/KE - DSN/1992; JNK - 09/MAS/KE - DSN/1992; JNK - 09/TEK/KE - DSN/1992; JNK - 09/INT/KE - DSN/1992

Alamat : Puslitbang KIM-LIPI, Kompleks PUSPIPTEK, Serpong - Tangerang, 15310
Telp. (62-021) - 7560533 - 7560534 - 7560535 - 7560538 - 7560562 - 7560571 - 7560906 Fax. (62-021) - 7560568 Telex 45512 PPIT IA

Dilarang keras mengutip/memperbanyak dan/atau mempublikasikan sebagian isi Sertifikat ini tanpa izin Puslitbang KIM-LIPI
Sertifikat ini sah bila telah dibubuhi cap Puslitbang KIM-LIPI



Appendix A2-3 Calibration Report of BBIK

DEPARTEMEN PERINDUSTRIAN
BADAN PENELITIAN DAN PENGEMBANGAN INDUSTRI
BALAI BESAR INDUSTRI KIMIA
PUSAT PELAYANAN KALIBRASI DAERAH JAKARTA
Pekayon - Pasar Rebo, Jakarta Timur 13069 PO. Box 6916 JATPK
Telp. : (021) 8714928, 8717438 Fax. : (021) 8714928

Nomor laporan : CF 04/J 034/Jkt
Halaman 1 dari 3 lembar

LAPORAN KALIBRASI

Nomor Pekerjaan : J 034/Jkt
Tanggal laporan : 25 Agustus 1994
Nama perusahaan : PT. BAKRIE PIPE INDUSTRIES
A l a m a t : Jl. Raya Bekasi Km. 27
BEKASI BARAT
Telpon / Fax : (021) 4600826 - 4602187
Type alat : External Micrometer ; Ketelitian : 0,01 mm
Range : 300 - 400 MM
Nomor seri : A - 04 - 33
merek : MITUTOYO
Nomor order : 286/BPI/Lab.GAE/VIII/94

Standar dan prosedur kerja yang digunakan : ISIR B 7502-1979 ;
2.04

Tanggal penerimaan : 18/08/'94 ; Tanggal kalibrasi : 24/08/'94

Kalibrasi dilakukan pada : $T = (20 \pm 1) ^\circ C$; R.Hum. = $(50 \pm 5)\%$

Alat yang digunakan : - Gauge block set grade 1 A/001/LS/'92
- Gauge block set grade 1 A/002/LS/'92
- Gauge block set grade 1 A/003/LS/'92
- Stand Micrometer A/018/LS/'92

Hasil pengukuran sesuai berdasarkan hasil kalibrasi, Kecuali kerataan mulut ukur tetap untuk range 350 + 400 mm dan kesejajaran mulut ukur untuk range 300 + 350 mm dengan standar yang dipakai.

Nama : Ir. Hayatun Nusuf
N I P. : 090002999
Jabatan : Ka. Balai Besar Industri Kimia




Tanda tangan dan stempel

SSO/ab

PERHATIAN : 1 Hasil kalibrasi ini hanya berlaku untuk alat ukur tersebut.
2 Dilarang mengutip/menyalin isi laporan, tanpa seljin tertulis dari Laboratorium Pusat Pelayanan Kalibrasi Daerah Jakarta.

Appendix A2-4 Technical Evaluation of Measurement/Calibration Staffs

	Agency for Industrial Research and Development CALIBRATION AND TESTING NETWORK	APPENDIX N° AP1_OP6
		PAGE 1 OF 2 PAGES
		ISSUE No: 3
	OPERATING PROCEDURE	ISSUE DATE: 20 Dec 94

METROLOGY - OPERATOR TRAINING
 APPROVED PERSONS

NAME: SUGIHONO : SG

DATE: 13-07-1994
 REVIEW DATE:

DOCUMENT

EQUIPMENT	LEVEL OF EXPERIENCE				
	1	2	3	4	5
DEPTH MICROMETER	SG				
DIAL TEST INDICATOR (LEVER TYPE)	SG				
VERNIER, DIAL AND DIGITAL CALIPER				SG	
EXTERNAL MICROMETERS UP TO 500 MM				SG	
DIAL GAUGES (PLUNGER TYPE)				SG	
VERNIER DEPTH GAUGES UP TO 300 MM	SG				

SIGNED BY: QUALITY MANAGER

↑
Best

Filename: AP1_OP6.003

IR. R.A. SULAEMAN
 NIP. 090008729

Appendix A2-5 Calibration Manual

				CALIBRATION PROCEDURE
				Page 1 of 4 pages
TITLE : CALIBRATION OF INDUSTRIAL MANOMETER AND PRESSURE GAUGES.				
Procedure number : TCP 008 Issue number : 1 Issue date : January 25, 1994				
Compiled by: <u>Johan DE CLERCQ</u> Department: <u>CTSN</u> Date: <u>January 25, 1994</u>				
Authorised by: Technical Manager: _____ Date: _____ Quality Manager: _____ Date: _____				
Revision	Issue Date	Initiated by	QA ch'd by	Revised pages and reason for change
UN CONTROL				
			Issue nr.	Page nr. 1 2 3 4 5 6 7 8 9 10 11 12 Rev/status

Filename: TCP_008.003

Appendix A2-6 Work Sheet for Calibration



DEPARTEMEN PERINDUSTRIAN
BADAN PENELITIAN DAN PENGEMBANGAN INDUSTRI
BALAI BESAR INDUSTRI KIMIA
PUSAT PELAYANAN KALIBRASI DAERAH JAKARTA
Pekayon - Pasar Rebo, PO BOX 6916 JATPK Tel.: 021-8717438
Tel./Fax: 021-8714928
Jakarta - Timur (13069)

WORKSHEET FOR CALIBRATION OF MANOMETER/GAUGES

Worksheet number:
Page 1 of 3 pages

TCWS008 / JKT

Jobnr.:

Data client: (name)
(adress)
(tel + fax)

Data item: (type)
(range)
(serialnr.)
(brandname)

UN CONTROL

(graduation)

mm/sd

Applicable standards and calibration procedure: TCP 008 / NBN 363

Date of receipt:

Date of calibration:

The calibration was performed under standard conditions: T = (±) °C; R.Hum. = (±) %

Equipment used: Comparison test pump
Controle manometer

Brand: RVR range
Serial no:
Range:
Class/accuracy:
Certificat no:

Comment:

(Signature, name & function of operator)



Appendix A2-7 Calibration Report

PUSAT PENGUJIAN MUTU BARANG

S. 1869

Lembar ke 2 dari 2 lembar

Nama Alat : PLASTIMETER
 Tempat Kalibrasi : LAB. PT. FRASIDHA ANEKA NIAGA I
 JL. KI KEMAS RINDO, OGAN BARU, KERTAPATI - PALEMBANG
 Tanggal Kalibrasi : 23 SEPTEMBER 1994

Suhu : -°C
 Kelembaban : -%

HASIL KALIBRASI

1. Preheating period
 - Rata-rata : 15 detik (10 kali Pengukuran)
 - Standar Deviasi : ± 0.1 detik
2. Load period
 - Rata-rata : 15 detik (10 kali pengukuran)
 - Standar Deviasi : ± 0.1 detik
3. Kalibrasi Beban Rata-rata : 9.983 Kg ± 0.01 Kg
4. Kalibrasi Poros Vertikal : 1.3 mm ± 0.1 mm
5. Kalibrasi Funch : 3.1 mm ± 0.1 mm

Alat tersebut telah dikalibrasi dengan metoda FRIM Malaysia.

Petugas Kalibrasi

Nofzelisman

PK. 030



JARINGAN NASIONAL KALIBRASI

Akreditasi JNK - DSN No. 022/KEP/KOM-E-JNK/1989

No. 044/KOM-E/JNK/1992

* Dilarang keras mengutip/mempertanyakan dan/atau mempublikasikan sebagian isi sertifikat ini tanpa izin PPMB
 * Sertifikat ini sah bila telah ditandatangani cap Departemen Perdagangan

SUCOFINDO MAIN BUSINESS

- INSPECTION
- CONTROLL
- ASSESSMENT
- SUPERVISION

OF QUALITY, QUANTITY AND CONDITION
OF
GOODS AND SERVICES

lsj20c

Annex 3: Industrial Methodology and Calibration Service Organization



1 Research and Development Centre for Calibration, Instrumentation & Metrology

(Pusalitbang Kalibrasi, Instrumentasi & Metrologi: KIM-LIPI)

1.1 General Profiles

KIM-LIPI was established in 1967 as National Institute for Instrumentation under Presidential Decree No. 128. In 1983, it was transferred to Science and Technology Development Center (PUSPIPTEK), constructed a new building and procured new equipment to promote calibration service as part of science and technology development program. In 1986, it was changed to its present name under Presidential Decree No.1. Then in 1989, it became responsible for technical management of national physical standards, and was designated as a national standards institute under Presidential Decree No.7. It now belongs to Science and Technology Council.

1.2 Organization and Role

KIM-LIPI consists of 6 divisions, Instrumentation R&D, Applied Instrumentation R&D, Instrumentation Development Technology, Metrology & Calibration R&D, Service & Information, and Administration (Chart A3-1, A3-2 and A3-3). Its activities are divided into research and development related to instrumentation technology and in the fields of metrology and calibration. It has approximately 400 employees.

Metrology and Calibration R&D Division is divided into the following 6 laboratories.

(1) Force & mass metrology laboratory

The laboratory has 11 staff and conducts metrology and calibration R&D and services related to force, pressure, mass, density, viscosity, and volumenometer.

(2) Electrical metrology laboratory

10 engineers and technicians conduct metrology and calibration R&D and services related to voltage, radiation, power, capacity, inductance resistance, frequency, and time.

(3) Temperature metrology laboratory

The laboratory is staffed by 10 persons and conducts metrology and calibration R&D and services related to temperature, humidity, and moisture meter.

(4) Acoustical metrology laboratory

4 research staff is engaged in metrology and calibration R&D and services related to microphone, noise meter, and virbrometer.

(5) Optical metrology laboratory

The laboratory has 6 research staff and conducts metrology and calibration R&D and services related to standard lamp and illuminometer.

(6) Dimensional metrology laboratory

9 research staff is engaged in metrology and calibration R&D and services related to length, linearity, flatness, surface roughness, and roundness.

Breakdown of research staff by area and level of specialization at each laboratory indicates the shortage of engineers and technicians, i.e., the number of research staff in a field is four at most, and only one in some fields.

1.3 Activities and Services

KIM-LIPI is a member of JNK and acts as its central figure. It provides calibration service for equipment of the JNK member organizations, government research institutes, and private enterprises in the areas of photometry, length, mass, time, electricity (current), temperature, density, and assembly quantity. The results of calibration are recorded in a calibration report that specifies the date of calibration, the name of a calibrator, type of calibration conducted, equipment calibrated, standards used, and their traceability, and a certification label is affixed to the calibrated equipment.

Calibration activities of the six laboratories remained at a level of 800 cases per year between 1980 and 1985 (Chart A3-4 and A3-5). By category of calibration, electricity, temperature, force and mass, and dimension, the number of cases are more or less the same, while the number of photometry and acoustic calibration is one fifth that of the above four fields. During the ensuing four year between 1986 and 1989, the number of calibration services increased from 1,000 to 1,500. Service related to force and mass accounted for the largest share, followed by dimension. In fact, these fields showed strong growth. Between 1990 and 1993, the number of services grew to a record level each year. Using the 1989 figure as the baseline, the number of calibration services in 1990 increased by 10%, followed by 70% in 1991, 2.6 times in 1992, and 5 times in 1993. (Chart A3-6) to clearly indicate rapid growth after 1991. While growth has occurred in all the six fields, two fields - dimension and force/mass - have recorded marked growth. The number of services in these fields handled by each person doubled in 1993, totaling 323 and 207, respectively, and closing to a handling capacity (Chart A3-6). Given future industrial development and an anticipated increase in calibration demand, KIM-LIPI clearly needs to reinforce its calibration equipment and staff.

1.4 Equipment

KIM-LIPI's facilities are located in Bandung and Serpong, and have total floor areas of 1,800m² and 21,000m², respectively, with headquarters located in Serpong. Both of the facilities have ample working space and are equipped with good ventilation and air-conditioning systems, as well as lighting to provide excellent testing environment.

As for calibration and testing equipment, national standards are listed in Chart A3-7, and the equipment owned by each of the six laboratories, and the level and range of calibration service are summarized in a list which is kept at the laboratory. All the equipment was purchased within the past 10 years and do not require urgent upgrading. In fact, each laboratory has sufficient equipment to provide necessary calibration service in its designated fields. Also, KIM-LIPI has a vehicle equipped with equipment providing field calibration service. On the other hand, testing equipment is partly insufficient in quantity and needs to be augmented to meet current and future needs.

2 Calibration Organizations under the Ministry of Industry

2 research institutes under BPPI, B4T and BBLM, participate in JNK and provide calibration services in their responsible fields.

(1) B4T

B4T renders calibration service for equipment of private enterprises and local laboratories in the fields of force, pressure, temperature, mass, and volume. The results of calibration are recorded in a calibration report that specifies the date of calibration, the name of a calibrator, type of calibration conducted, the name of person who requested calibration, the name of equipment calibrated, standards used, and their traceability. A certification label is affixed to the calibrated equipment. The number of calibration services totaled 585 in 1991, 648 in 1992, and 650 in 1993.

(2) BBLM

The institute provides calibration service for private enterprises and local laboratories in the categories of length, force, pressure, hardness, shape, and torque. The calibration results are recorded in a calibration report by specifying the date of calibration, the name of a calibrator, type of calibration conducted, the name of person who requested calibration, the name of equipment calibrated, standards used, and their traceability. A certification label is affixed to the calibrated equipment. BBLM conducted 65 calibration services in 1991, 150 in 1992, and 439 in 1993.

(3) BBIK

Under technical guidance of BBLM, BBIK performs calibration service for private enterprises in the fields of length and pressure. The calibration results are recorded in a calibration report that specifies the date of calibration, the name of a calibrator, type of calibration conducted, the name of person who requested calibration, the name of equipment calibrated, standards used, and their traceability. A certification label is affixed to the calibrated equipment. In 1993, BBIK conducted 16 calibration services.

B4T, BBLM, and BBIK mostly have new calibration equipment that does not require urgent upgrading, but some of them are in short supply.

3 Calibration Organization under the Ministry of Mining and Energy

PLN-LMK under the Ministry of Mining and Energy was established as Electrical Research Institute (PLN) at the end of 1961, and was reorganized to the present institute in 1987 under the Ministry of Mining and Energy Order No. 1561K/02/M.PE/1987. Its major responsibilities are research and development, dissemination, consulting, training in the fields of thermal power generation, hydro-electric power generation, and general electricity. PLN-LMK consists of 5 departments (Planning & Research, Scientific Service, Standardization, Operation Service, and Administration), 3 laboratories (Electricity, Hydro-Electric Power Generation, and Thermal Power Generation), and 2 service units (Power System Research and Investigation Service) (Chart A3-8). PLN-LMK has 441 employees.

PLN-LMK provides testing and calibration service as a member of JNK. Standards and Instrumentation Division of Electrical Laboratory is responsible for testing and calibration of electrical instruments, and Instrumentation and Materials Division of Thermal Power Generation Laboratory performs testing and calibration of instruments measuring non-electrical characteristics.

Fields of calibration include energy, capacity, resistance, temperature, watt, electric current, and voltage. The calibration results are recorded in a calibration report (Appendix A3-1) that specifies the date of calibration, the name of a calibrator, type of calibration conducted, the name of person who requested calibration, the name of equipment calibrated, standards used, and their traceability. A certification label is affixed to the calibrated equipment.

Calibration equipment is sufficient in capability and variety, although some of them are in short supply. Calibration equipment owned by Standards and Instrumentation Division and calibration levels are shown in Chart A3-9.

4 Private Organization

PT. Sucofindo joins JNK as a private enterprise and provides calibration service in the areas of pressure and moisture. It maintains traceability of its own calibration equipment under contract with KIM-LIPI. Calibration equipment is new and sufficient in capability, albeit insufficient in terms of quantity.

5 Directorate of Metrology (Direktorat Metrologi: DOM)

5.1 General Profiles

DOM under supervision of the Ministry of Commerce, is responsible for statutory metrology service. Together with 47 metrology laboratories that are local offices of the Ministry of Commerce, it forms a nationwide statutory metrology service network. As additional 8 certification offices will be established by the end of 1994, certification and calibration services will be provided by 56 organizations (DOM and 55 metrology offices), starting in 1995. DOM is a member of JNK and its primary responsibilities include the calibration of standards, type inspection, technical assistance for local certification offices, the improvement and upgrading of facilities and equipment for certification.

5.2 Organization

DOM consists of 5 departments consisting of, Measuring Facilities, Mass Measurement, Flow Rate Measurement, Length and Volume, and Administration and Information. It is staffed by 144 persons, of which 32 are official inspectors. Each department consists of the following divisions:

Measuring Facilities Department:	Software, Hardware, and Public Relations divisions
Mass Measurement Department:	Mass Standards, Electronic/Mechanical Measurement, and Force/Pressure divisions
Flow Rate Measurement Department:	Oil Meter, Liquefied Gas Meter, Water Meter, and Electrical/Time Measurement divisions
Length and Volume Department:	Tank Measurement, Taxi Meter, Density, Temperature and Viscosity divisions
Administration and Information Department:	Legal Proceeding and Data Collection, Instrumentation, Packaging Product Control, and Information divisions

DOM's organizational chart is shown in Chart A3-9.

5.3 Equipment

DOM's facility has total floor area of 4,054m², half of which is occupied by laboratories. Most laboratories are insufficient in ventilation, air-conditioning, and lighting, thus needing to be improved urgently.

Testing and calibration equipment is sufficient only in the two categories, mass and length. Other types of equipment are in short supply, both in quality and quantity, and require replenishment.

5.4 Local Metrology Offices

Among the local metrology offices, the Bandung office (Propinsi Jawa Barat Bidang Metrologi) as described below as a typical example. The office consists of 4 divisions, Metrology and Mass, Length, Volume, Electrical Current and Flow Rate, Inspection and Dissemination and Information, and Measuring Instruments. It has 43 employees, of which 13 are inspectors. Its primary duties include certification of balances, weights, rulers, watt-hour meters, gasoline meters, tax meters, and volumenometers and flow meters for filling stations and tank lorries. Certification records over five years between 1988 and 1992 are shown in Chart A3-11. The number of new certifications increases year by year from around one half the number of re-certifications in 1989 to 766,567 cases, reaching about the same level. In particular, 1992 saw remarkable growth with the total number of new certifications and re-certifications amounting to 1,540,579, which seem to be near the facility's handling capacities in terms of both equipment and manpower.

6 Quality Testing Center (PPMB)

PPMB is an institute under the Ministry of Commerce conducting testing and inspection services for non-oil export products. It supervises 20 local laboratories and forms a testing and inspection network. As a member of JNK, it calibrates testing equipment of the network member organizations in the areas of length, mass, and temperature. The calibration results are recorded in a calibration report that specifies the date of calibration, the name of a calibrator, type of calibration conducted, the name of person who requested calibration, the name of equipment calibrated, and standards used, accompanied by a certificate. PPMB maintains traceability of its calibration equipment under contract with DOM and KIM-LIPI.

Metrology and calibration equipment of the JMK member organizations covering both industrial metrology and statutory metrology, and calibration levels are summarized in a list which is kept at the laboratory.

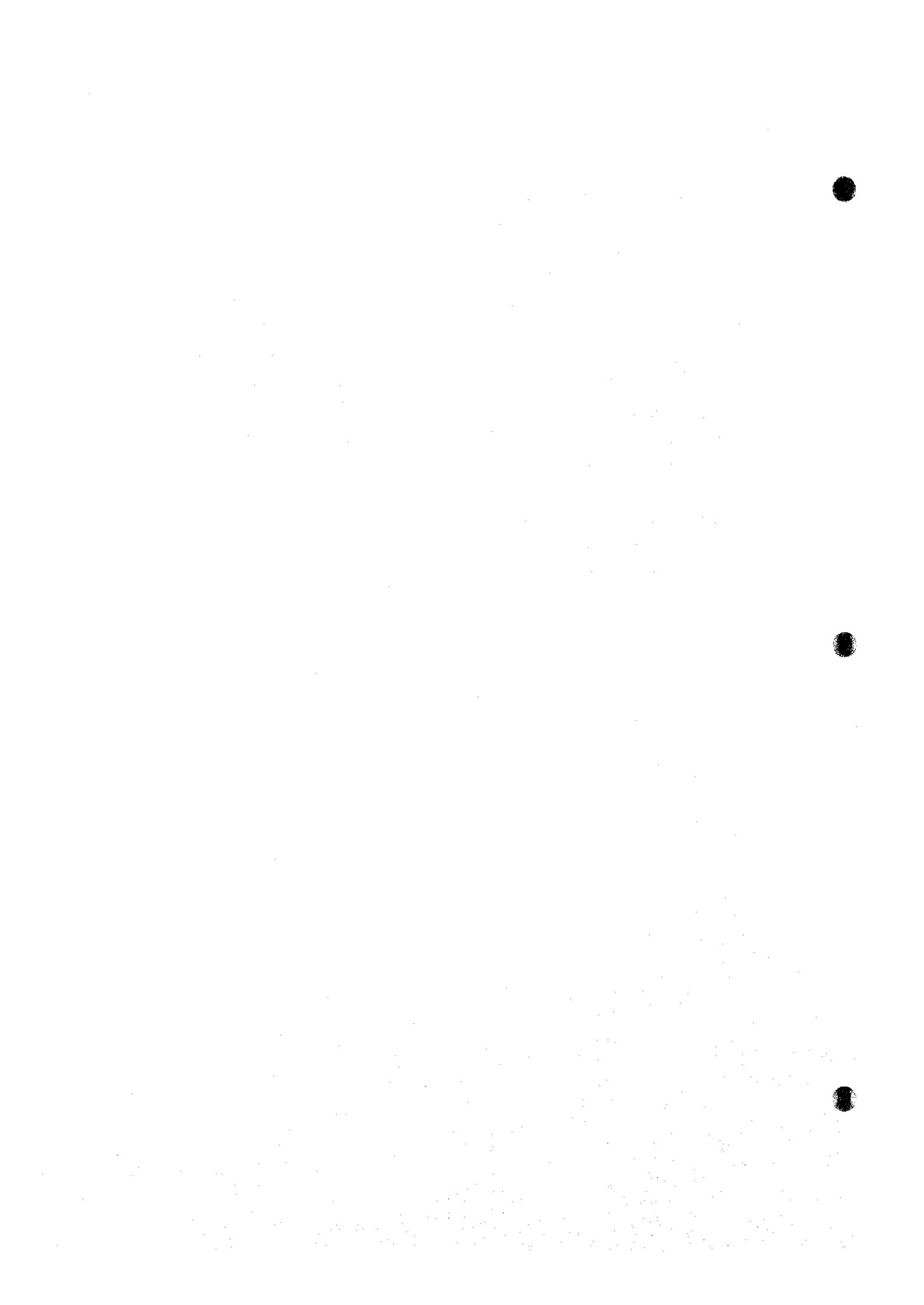


Chart A3-1 The Position of LIPI in Government Structure

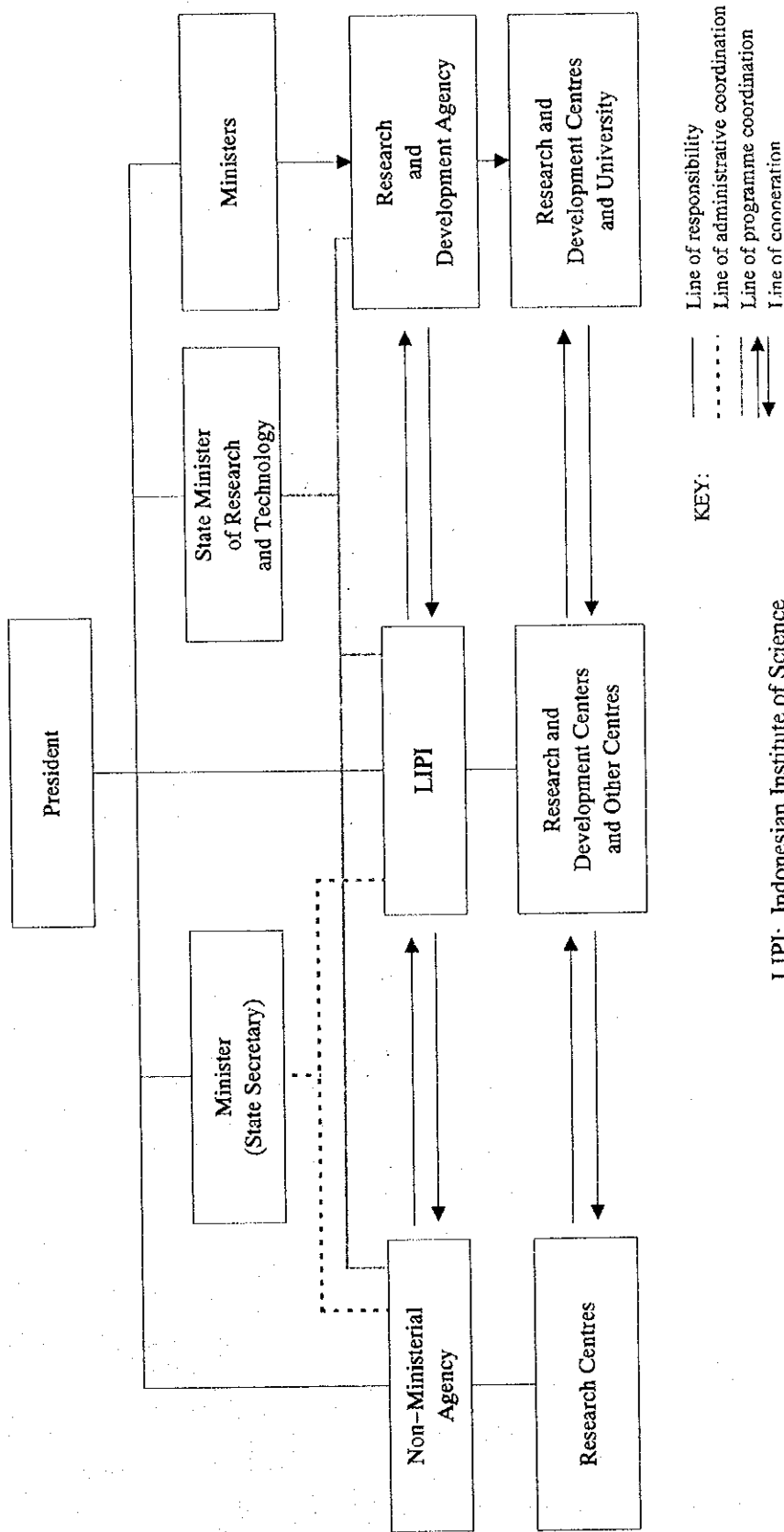


Chart A3-2 Organizational Structure Indonesian Institute of Science

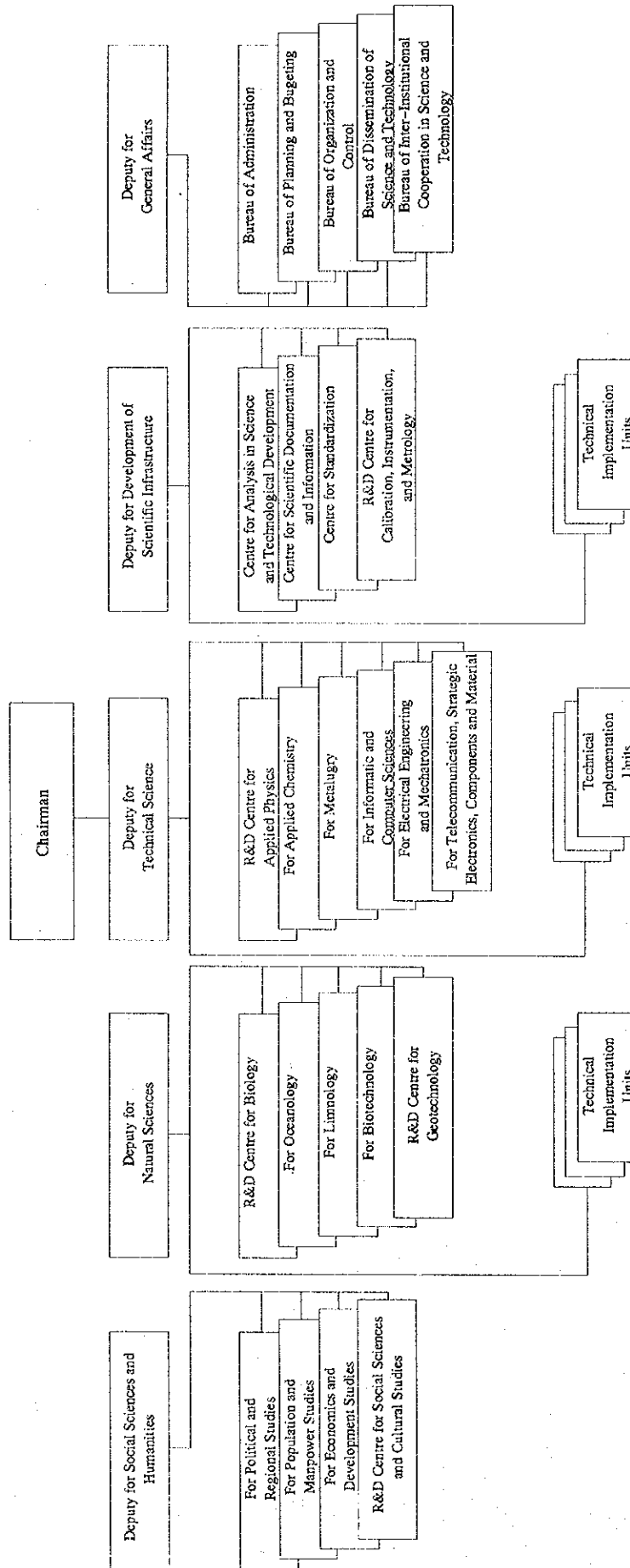


Chart A3-3 Organization Structure R & D Centre for C.I.M. - LIPI

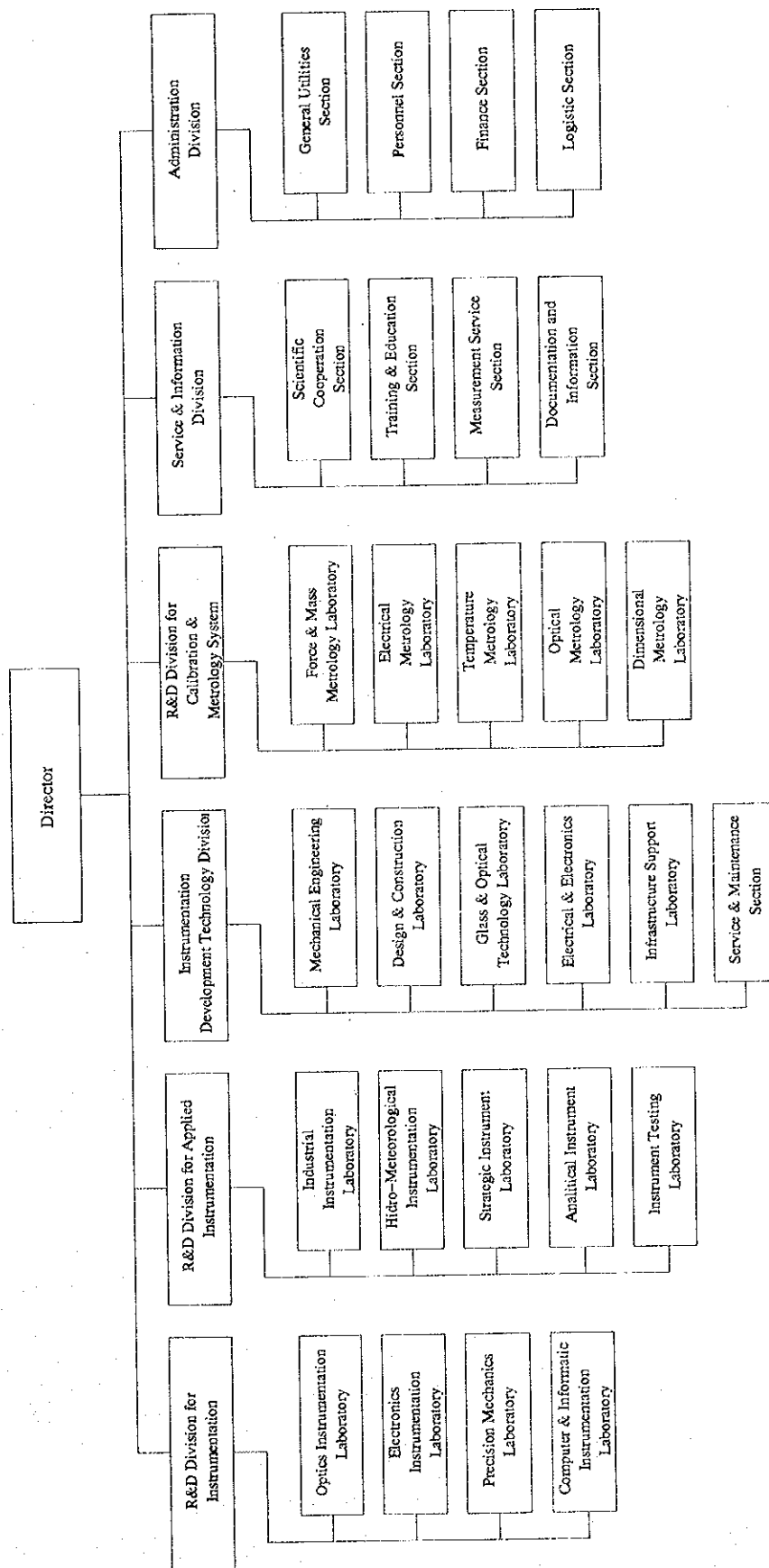


Chart A3-4 Statistical Data in Calibration Services of LIN - LPI (1980 - 1985)

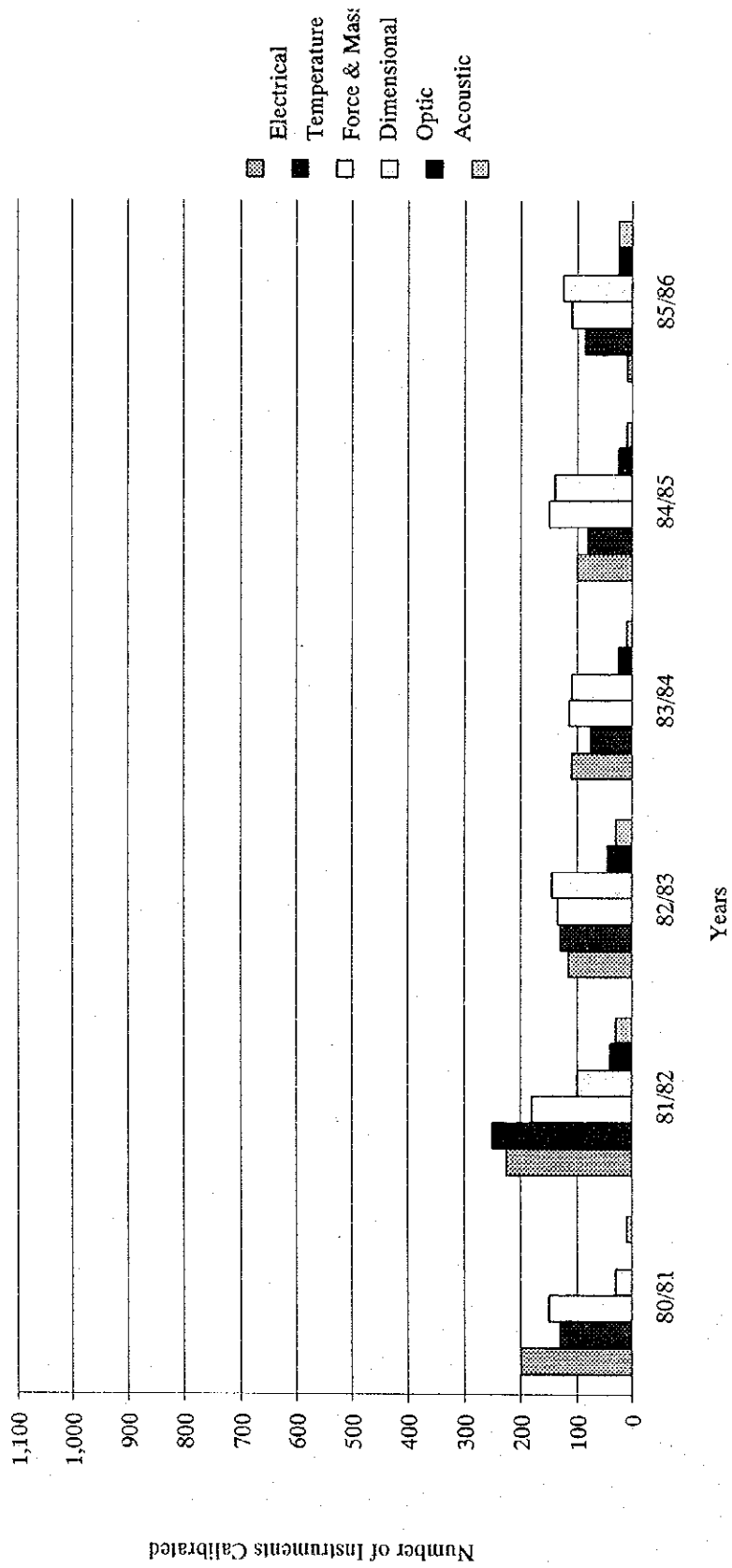


Chart A3-5 Development of Calibration Services in the Laboratories of Puslitbang KIM - LIPI

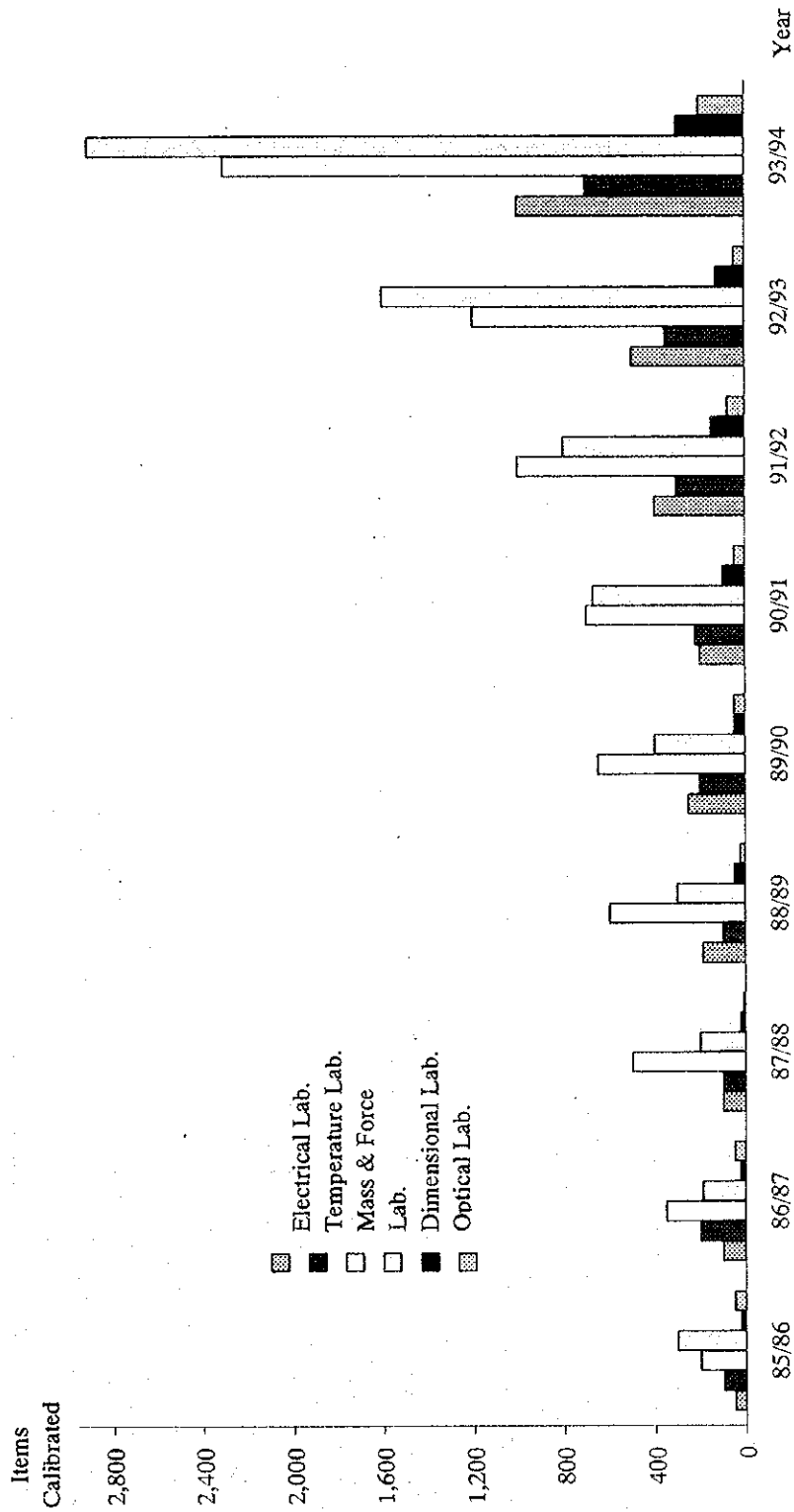


Chart A3-6 Measurement Services of KIM-LIPI from 1989 to 1993

	Year														
	1989			1990			1991			1992			1993		
	%	No. of times vs. '89	Manning/year	%	No. of times vs. '89	Manning/year	%	No. of times vs. '89	Manning/year	%	No. of times vs. '89	Manning/year	%	No. of times vs. '89	Manning/year
Dimension	29	1.0	46	33	1.2	58	30	1.7	81	43	3.7	174	42	6.9	323
Force & Mass	37	1.0	47	37	1.1	53	36	1.7	81	31	2.2	104	32	4.4	207
Electric	16	1.0	17	10	1.0	17	16	2.4	40	13	2.9	48	13	5.6	94
Temperature	12	1.0	23	12	0.8	19	11	1.2	27	9	1.4	31	9	2.7	63
Optic	3	1.0	7	5	1.1	14	4	2.5	17	3	2.4	17	3	4.5	31
Acoustic	3	1.0	11	3	1.0	11	3	1.5	16	1	1.0	11	1	2.4	26
Total No. of Services		1,420		1,590		2,470		3,660		7,040					
Increasing Ratio		1.0		1.1		1.7		2.6		5.0					

Chart A3-7 Number of Staffs in Laboratories (1/2)

Laboratory	No.	Field	Year		
			Professional staff	Technical staff	Total
Mass Metrology	1	Mass	2	2	4
	2	Force	1	1	2
	3	Pressure	1	2	3
	4	Density/viscosity	-	-	-
	5	Flow/volume	1	1	2
		Total	5	6	11
Electrical Metrology	1	AC/DC Voltage	2	1	3
	2	Impedance	1	1	2
	3	Power/energy	1	1	2
	4	RF/Microwave	1	-	1
	5	Time/Frequency	2	-	2
		Total	7	3	10
Temperature Metrology	1	Radiation thermometry	2	-	2
	2	Thermocouple thermometry	-	2	2
	3	Platinum resistance thermometry	1	2	3
	4	Hygrometry	-	2	2
	5	Moisture	1	-	1
		Jumlah	4	6	10

Chart A3-7 Number of Staffs in Laboratories (2/2)

Laboratory	No.	Field	Year		Total
			Professional staff	Technical staff	
Acoustic Metrology	1	Sound measurement & Env acoustics	-	1	1
	2	Vibration	1	-	1
	3	Under-water & Electro acoustics	-	1	1
	4	Architectural acoustics	-	1	1
		Total	1	3	4
Optical Metrology	1	Photometry	1	1	2
	2	Radiometry	1	1	2
	3	Spectrophotometry	1	-	1
	4	Densitometry	-	1	1
		Total	3	3	6
Dimensional Metrology	1	Length metrology	1	1	2
	2	Angle metrology	1	1	2
	3	Surface metrology	1	1	2
	4	Geometrical metrology	-	1	1
	5	Coordinate metrology	1	1	2
		Total	4	5	9

Chart A3-8 Organization Structure of PLN-LMK

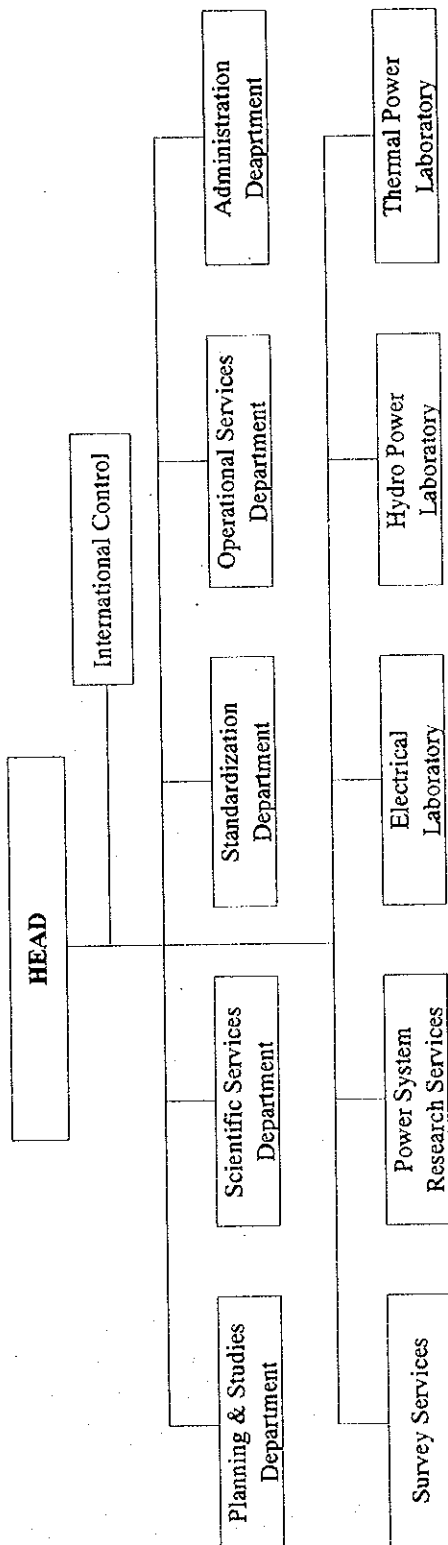


Chart A3-9 Calibration Facilities of PLN-LMK Electrical Laboratory

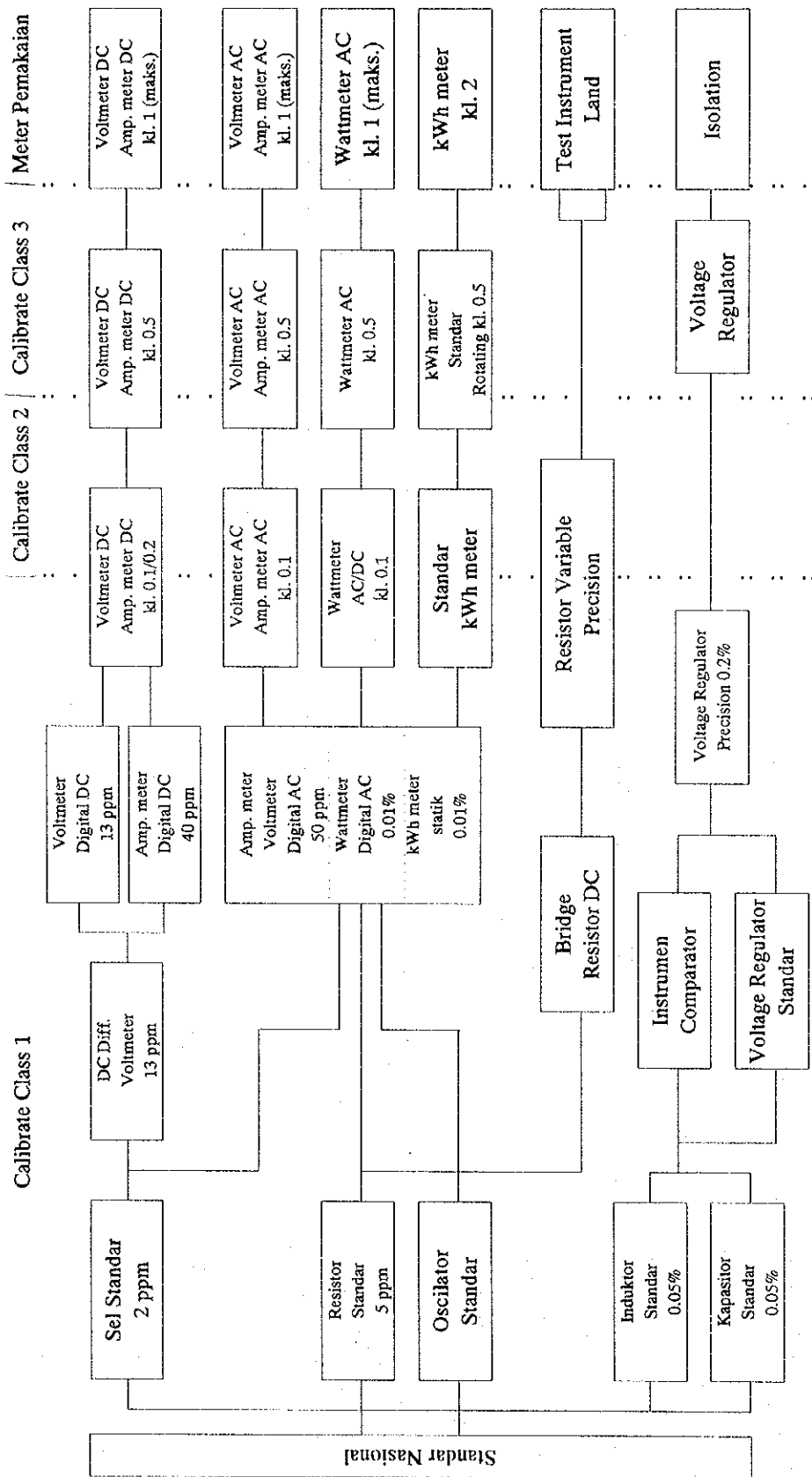


Chart A3-10 Organization of DOM

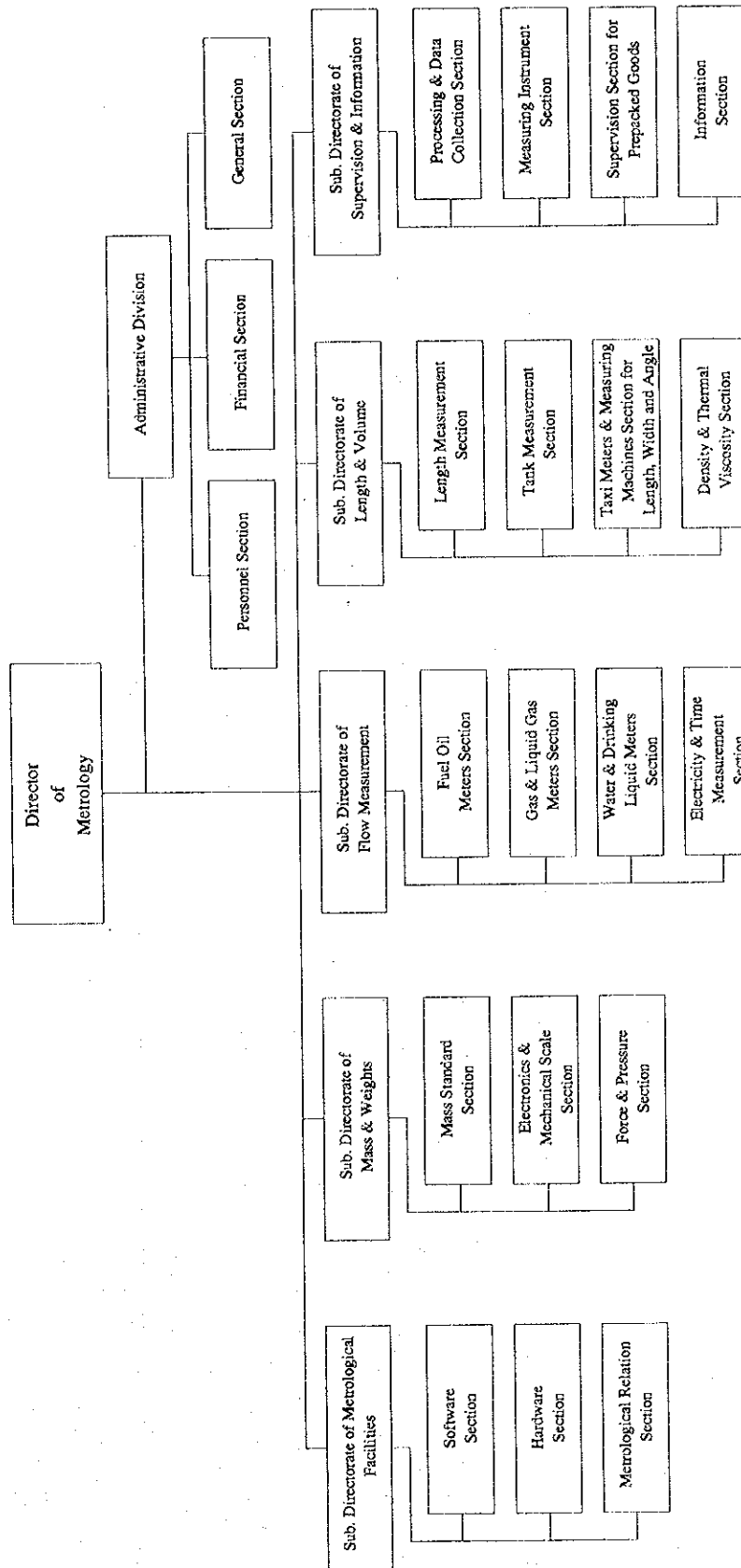


Chart A3-11 Number of Calibration Services of Province Institute (1988-1992)

	Year				
	1988	1989	1990	1991	1992
New request	231,986	382,366	429,207	553,283	766,567
Re-calibration	650,632	704,170	693,094	748,412	774,012
Total	882,618	1,086,536	1,122,301	1,301,695	1,540,579
Increasing Ratio	1.0	1.2	1.3	1.5	1.7

Appendix A3-1 Calibration Report of PLM-LMK



PT. PLN (PERSERO) - PUSAT PENYELIDIKAN MASALAH KELISTRIKAN
State Electricity Corporation Ltd. - Electric Power Research Centre
 Jalan Duren Tiga, Jakarta 12760, Kotak Pos 6701/JKSRB - Jakarta 12067
 Telepon : 7973774 - 7993908 - 7992098 - 7982035 Facsimile : 7991762

LAPORAN KALIBRASI
 calibration report

LABORATORIUM LISTRIK
 electrical laboratory

No. _____ LEMBAR KE : 1 DARI : 2 LEMBAR
 sheet no. of sheets

NAMA ALAT : TRANSFORMATOR ARUS
 instrument
PABRIK : _____ TIPE : _____
 manufacture type
JULAT UKUR PRIMER : 1250 AMPERE
 primary range
JULAT UKUR SEKUNDER : 5 AMPERE Burden : 15 VA
 secondary range
NOMOR SERI : 94/586902 KELAS : *
 serial number class
PEMINTA JASA : _____
 client

HASIL KALIBRASI
 calibration result

- Baik, kesalahan ukur didalam batas kelasnya.
- Kesalahan maksimum :
 Rasio : + 0,72 % pada arus 120 % In
 di beban 5 VA .
 Sudut fase : + 9,0 menit pada arus 5 % In
 di beban 15 VA .
- * Kelas 1 pada 1S1 1S2
 Kelas 10P10 pada 1S1 2S2

SUHU SEKITAR : 27 °C KELEMBABAN : 75% - 80%
 ambient temperatur humidity
TANGGAL KALIBRASI : 3 Nopember 1994 BERLAKU SAMPAI : Nop. 1997
 data of calibration calibration due
TEMPAT KALIBRASI : Lab. Listrik PT. PLN (Persero) PPMK
 place of calibration

DIKALIBRASI OLEH : _____ DISETUJUI OLEH : _____
 calibrated by approved by

AM-HQ

Ir. Tony Rochaswadi
 KBSM

