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LICENSING OF RADIOACTIVE MATERIALS  
AND FACILITIES IN THE PHILIPPINES

by

ALEJANDRO J. MATEO

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Philippine Atomic Energy Commission  
Diliman, Quezon City

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**ABSTRACT:**

The importation, acquisition, possession, use, sale and/or transfer of radioactive materials need to be regulated and controlled in order to safeguard the importer, possessor, user or seller and the general public as well. The Philippine Atomic Energy Commission pursuant to Republic Act No. 2067, as amended, and Republic Act No. 5207, has been charged by the government to control, regulate and license all the radioactive materials and facilities in the Philippines. Licensing and control is accomplished through a system of Rules and Regulations applicable to all importers, possessors, users or sellers of radioactive materials.

LICENSING OF RADIOACTIVE MATERIALS  
AND FACILITIES IN THE PHILIPPINES<sup>(1)</sup>

by

Alejandro J. Mateo

INTRODUCTION:

Certain activities such as the handling and use of radioactive materials, radioisotopes, and the shipment and transport of radioactive materials create radiation hazards which may affect the health and safety of both the persons engaged in such activities and the general public. Like any other human activity presenting serious hazards to the public, all activities involving the application of atomic energy require government regulations and control to ensure uniform and full protection to both the radiation workers and the general public according to prescribed standards.

In general, private action by the individual citizen in all atomic energy activities, especially involving the handling and use of radioactive materials, will not be enough to protect him and the public from the potential danger of radiation. The government must step in to protect public interest and the interest of national security by taking such measures as are appropriate, relevant and necessary. Thus, within the framework of Republic Act 2067, as amended, and Republic Act 5207, the Philippine Atomic Energy Commission has promulgated and prescribed Rules and Regulations on the Acquisition, Possession and Use of Radioactive Materials in the Philippines which took effect on April 27, 1959.<sup>(2)</sup>

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(1) Data and information as of June 30, 1976.

(2) Official Gazette, Vol. 55, No. 17, April 27, 1959.

The Commission's control and supervision over radioactive materials and facilities are achieved by a regulatory and licensing system in accordance with the said Rules and Regulations. The licensing and regulatory system consist of the adoption and publication of various safety rules and regulations which prescribes the guidelines, qualifications, type of training, adequacy of facilities, and other requirements to ensure safety.

Licensing of all facilities and users enables the Commission to know at all times the identity of the persons or institutions, as the case may be, who possess the radioactive material and who should be responsible for its safekeeping. Part of the licensing is the performance of periodic radiological health and safety inspections by the Commission to verify whether or not the license holder is maintaining and keeping the standards of safety as specified by the Commission's Rules and Regulations.

From the year 1958 when the Philippine Atomic Energy Commission was formally organized up to the end of June 30, 1976, a total of Two Hundred Sixteen (216) original licenses and permits were issued by the Commission. These included the licenses and permits which were later on cancelled upon the request of the license and permit holders. Table I shows the various reasons for the cancellation of licenses and permits.

Application for and Issuance of a PAEC License and Permit.

The Philippine Atomic Energy Commission issues two types of licenses: a permit to import and a user license. A permit to import is issued to allow only the importation and receipt of the radioactive materials or equipment incorporating the radioactive materials. This is the permit

usually given to those engaged in the sale or transfer of radioactive materials. The permit does not allow the use of the materials or equipment by permit holder. The permit allows the holder to sell or transfer radioactive materials and equipment incorporating radioactive materials only to licensed users in the country.

The permit to import is also first issued to an applicant to allow him to import the radioactive material. The permit does not allow the use of the radioactive materials or equipment incorporating the radioactive materials until after a user license is granted to the applicant. Such a license is obtained only after the relevant radiological health and safety inspection and evaluation have been made by the Commission of the applicant's facilities as well as the radioactive materials or equipment incorporating the radioactive materials received by the applicant.

As of June 30, 1976, the original number of this type of permit granted by the Commission totals Twenty-seven (27).

The user license is granted to applicants possessing the appropriate qualifications and the proper facilities. The license holder may be an institution or an individual person. The license grants the applicant the possession, handling and use of radioactive materials and equipment for the specific purpose as indicated in the license. The authorized use or uses may be for nuclear medicine, research, class experiments or demonstrations, and industrial applications. Table II gives the breakdown of licenses issued by the Commission.

Category of Licenses

For the purpose of this paper, holders of permits to import and user license issued by the Commission are categorized as follows: hospitals, medical doctors, private clinics, research, educational institutions, industry, and those engaged in commercial sale or transfer. (Under the category of industry, a further classification have been made with the total number of license holders under each sub-group shown. The classification is shown in Table III).

Institutions Engaged in the Medical Uses of Radioactive Materials.

In the recent years, as a result of the establishment of atomic reactors, artificially-produced radioisotopes became readily available from the smallest microcuries to millicuries to even hundreds or thousands of curies level. New fields of application for these radioactive materials have opened up in medical diagnostic and therapeutic procedures. Among these radioactive materials are the so-called unsealed sources wherein the isotopes are in the liquid or colloidal forms. They can be utilized in the localization of affected tumours, measurements of blood volume or blood flow and many other uses. As a result of this breakthrough in medical techniques, hospitals started to have their own nuclear medicine department and cancer centers.

As radiation research continued to progress, more of the radioisotopes are now being made into needles, seeds, wires and sealed applicators. They are now being applied for intracavitary therapy of cancers, ophthalmic treatments, etc. In the teletherapy treatment techniques, an external high-energy



beam is used for the exposure. Such high-energy sources commonly used as the Cobalt-60 and Caesium-137 sources. The ranges of activities of these tele-gamma sources varies from a thousand to about five thousand curies.

Some of the radionuclides being applied for a license are the more common ones such as Iodine-131, Phosphorous-32, Iridium-192 needles, colloidal Gold-198 and Technetium-99m generators. These materials may be available from Abbott, Amersham, Picker International and sometimes from the Commission's Radioisotope Production Division. The teletherapy units and sources are available from the Atomic Energy of Canada Ltd. (AECL); Siemens, Germany; and Keleket, U.S.A. Shimadzu and Toshiba companies in Japan manufactured teletherapy machines but the radioactive material or sources are obtained from AECL.

The first institution in the country to apply for and issued a user license for medical use of radioactive materials was the V.Luna Medical Center, AFP on September 27, 1959. A month later, the Philippine General Hospital's Nuclear Medicine Department and Cancer Institute also applied for authority to operate their individual departments. Thereafter, almost all the big hospitals in the Metro-Manila Area and in the Visayas and Mindanao regions have also organized their individual nuclear medicine and/or cancer units. The latest to be licensed<sup>(3)</sup> is the Cebu (Velez) General Hospital in Cebu City which will be using Iodine-125 for the diagnosis of thyroid disorders and other allied diseases of the thyroid glands.

Teletherapy facilities and radioactive materials are licensed after a thorough radiation hazards evaluation of the completed facility and eva-

(3) On May 13, 1976.

luation of the qualifications and experiences of the proposed user or users. To date, a total of Twelve (12) facilities have been granted a license to operate.<sup>(4)</sup> Table IV lists down all the existing teletherapy facilities in the Philippines.

Private Practitioners Engaged in the Medical Uses of Radioactive Materials.

A user license is not only issued to a particular institution. A user license may also be granted to medical practitioners who are not connected with any hospitals, whether government or private-owned. These are the medical specialists who have established a section of nuclear medicine in their clinics. Usually, they have obtained their expertise in the more advanced nuclear medical centers abroad and have established their practice here with the help of the more advanced and sophisticated procedures that involve the application of atomic energy.

On September 5, 1958, Drs. Salvador Laurena and Ernesto Medina-Cue applied to the Commission for the first licenses<sup>(5)</sup> to use radioactive materials in their medical practice. The radioisotopes applied for were

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- (4) As of this writing, there is a pending application for the operation and use of a 5,000 curies Co-60 Teletherapy Facility.
- (5) Actually, Drs. Jose L. Lapeña and Nestor Canoy of Manila and Cebu City respectively were granted a permit to use radioactive materials on November 27, 1956 by the then Isotopes Committee of the Inter-departmental Committee of Atomic Energy headed by the Secretary of Health. Dr. Lapeña used I-131 and Dr. Canoy used P-32. Dr. Lapeña has since then ceased to handle and use radioactive material and he did not re-apply for the license with the Philippines Atomic Energy Commission while Dr. Canoy after being licensed by the Commission for 4 years, emigrated to the US and have sold or transferred all the radioactive materials to Dr. Lydia R. Medalle of Cebu City. Drs. Laurena and Medina-Cue were also granted the permit by the same Committee but have re-applied with the Commission when the PAEC took over the functions of the defunct Isotope Committee.

Iodine-131 and Phosphorous-32 for diagnostic and therapeutic dosages. Since then, thirty-one (31) of this type of licenses for private practitioners have been issued by the Commission.

Licensees Engaged in Commercial Sale or Transfer of Radioactive Materials.

Commercial firms have started to engaged in the procurement and importation of the radioactive materials. These companies are undertaking the importation<sup>(6)</sup> of the radioactive materials for the license holders. The first of these firms is Abbott Philippines Inc. who filed its application on February 26, 1966 and was given the authority to engage in commercial sale or transfer of radioactive materials on March 1, 1966. On April 6, 1976, a permit was issued to Theo Pam Trading Corporation of Pasay City making a total of twenty-seven (27) original permits issued by the Commission.

Research Institutions Engaged in the Use of Atomic Energy.

Low activity radionuclides such as Caesium-137, Cobalt-60, Carbon-14, Strontium-90 and Phosphorous-32 are the most commonly used and applied for radioisotopes by those involved in research activities. The strengths or activities of these isotopes vary from a few microcuries to about 10 millicuries.

The majority of the licensed research institutions are government agencies. One big private licensed organization is the International Rice Research Institute which is being funded by the Rockefeller and Ford

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(6) A certificate of release and a certificate of transport is issued by PAEC and is required by the Bureau of Customs before the release of the imported radioisotopes or radioactive materials in the Manila International Airport and South Harbor Customs House.

Foundations.

The University of the Philippines' Institute of Hygiene was issued the first license on June 9, 1960 to handle and use radioisotopes for research purposes. The license was cancelled on April 30, 1969 upon the request of the licensee due to the completion of the research. Of the original thirty-four (34) licenses that have been issued to date, twenty-two (22) were to government-owned institutions and twelve (12) to private entities.

The latest license was granted to the Nuclear Power Division of the National Power Corporation (NPC)<sup>(7)</sup> on September 26, 1975 for the use of various radioactive materials in their environmental research programs in connection with the construction of the 620-megawatts nuclear power facility owned by the NPC.

Educational Institutions Engaged in the Use of Radioisotopes.

Educational institutions also avail of the licensing requirements of the Commission. Radioactive materials are used in class experiments and for demonstration purposes. Six (6) schools and university are still licensed to possess and use low-activity radioactive materials. One university has requested for the cancellation of its license on February 3, 1969 since it will no longer use radioactive materials in their class activities. The first license was issued to University of San Carlos in Cebu City on November 2, 1964 followed by the Ateneo de Manila University on March 7, 1968. The International School in Makati,

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(7) The NPC is a public corporation engaged in pure power generation and not basically a research institution.

Rizal is the latest to be granted a license on February 25, 1975.

Industrial Users of Radioactive Materials.

Individual users or companies engaged in industrial operations and processes make use of radioisotopes like Caesium-137, Cobalt-60, Radium-226 and Krypton-85. These materials are incorporated in peices of equipment which can be used for radiography of welds, level gauging, thickness gauging, density determination and weight control of raw materials and finished products.

The different industries licensed by the Commission and are involved in radiation work have been grouped into their general classifications and is shown in Table III. It will be noted that there is relatively larger number of firms (14 active license holders) involved in industrial radiography and non-destructive testing of materials. The first of these firms to be issued a license was the Standard-Vacuum Oil Corp. (Phils)<sup>(8)</sup>. The firm possessed a Cobalt-60 radiographic machine and 2 millicuries of encapsulated radium source for use in radiography of welds and thickness gauging. The license was issued on May 10, 1960. The latest license was issued on December 17, 1975 to the Construction Division of the Engineering Equipment Inc. for its "Iriditron" radiography machine incorporating a 30 curies Iridium-192 source.

In industrial radiography, the use of radioactive sources such as Cobalt-60 and Caesium-137 is believed by many users to be more advantageous and more economical than with the use of an X-ray radiography

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(8) Now named the Bataan Refining Corporation.

machine. One of the main advantages cited is that gamma radiography machines can be taken anywhere in field work because it does not require a power supply unlike the x-ray radiographic machines.

#### Mining Industry.

The number of licensed active users in the mining industry is twelve (12) as of June 30, 1976. Mining firms have made use of machines incorporating radioactive materials and such other chemicals like uranyl acetates and uranyl nitrates in their mines' operations.

The first mining firm authorized by the Commission to possess, handle and use radioactive materials was the Benguet Consolidated Mining Inc. in Baguio, Mountain Province on March 25, 1964. The most recent license was issued to Baguio Gold Mining Corp. for the possession, handling and use of a 300 millicuries Cs-137 source contained in an Ohmart Nuclear Density Gauge at the Sto. Niño Mines located at Tublay, Benguet on February 19, 1975.

#### Other Industries Involved in the Use of Radioactive Materials.

There are at present four (4) license holders in both the textile manufacturing and cement industries as well as the cigar and cigarette manufacturing and electronic parts and components manufacturing. Pacific Cement Co., Inc. in Surigao City was issued the license on October 12, 1966 to possess, handle and use a Cs-137 Nuclear Weigher.

To determine the desired thickness of finished fabrics and the square meter weights of textiles, a Mahlo area weight measuring equipment using Krypton-85 is used. Pioneer Texturizing Corp. on August 7,

1975 was issued the latest license to possess and use the Mahlo equipment at their Textile Finishing Department.

In the cigar and cigarette manufacturing industry, the first and the latest license holders were the La Suerte Cigar and Cigarette Factory on October 4, 1966 and the Associated Anglo-American Tobacco Co. on February 2, 1971, respectively. They possessed a nuclear thickness gauge incorporating Sr-90 beta sources serving as balancing and scanning sources.

For the electronic parts and components manufacturing, the Refrigeration Industries, Inc. was issued the license to use an Alnor Dew Pointer that incorporates a 6.5 microcuries Ra-226 on August 9, 1973. The Swiss Plating Phils., Inc. on the other hand, was licensed on June 1, 1976 to possess and use 50 millicuries each of Thallium-204 and Tellurium-127 radioactive sources.

In the construction of roads and highways, atomic energy is now being applied with the use of a Moisture-Density Meter incorporating a combination of Caesium:Beryllium sources. The three (3) license holders involved in the road construction in the country have this equipment.

The license issued to the Philippine Refining Corp. on June 8, 1966 was for the use of a Nuclear Level Gauge with one curie Sr-90 to continuously determine the level of finished products contained in boxes or containers before said boxes and containers are sealed. On May 6, 1976, the Central Vegetable Oil Manufacturing Co., Inc., popularly known as CENVOCO was issued the license to possess and use a 35 millicuries Cs-137 Ohmart Weigh Scaler.

The Commission has only issued two licenses for users of the Promethium-loaded heart pacemaker. They are Mrs. Asuncion Pedroso on September 19, 1973 and Ms. Twinkle Vinzons on March 2, 1974. Both have to be licensed and certified by the Commission and their movements monitored because of the radiation hazards or risks involved in the machines they are wearing. The pacemakers were implanted on them through the kindness of the First Lady, Mrs. Imelda Romualdez-Marcos.

Application Forms for a PAEC License.

There are two application forms and a supplementary form which an applicant has to fill to obtain a User License or a Permit to Import. PAEC Form DNRS-1 entitled "Application for a User License" (Appendix A) has to be filled up by an applicant involved in industry, medical practice and research. If the applicant is a medical doctor or a medical institution, besides the PAEC Form DNRS-1, he has to fill up PAEC Form DNRS-1 (Suppl. A) (Appendix B), for additional information needed in PAEC Form DNRS-1. An applicant for a Permit to Import has to fill up PAEC Form DNRS-1A entitled "Application for a Permit to Import and Commercial Sale or Transfer" (Appendix C).

The appropriate forms duly filled up together with the attachments or supporting documents asked for in the forms are evaluated and processed by the Department of Nuclear Regulations and Safeguards (DNRS) of the Commission. In the evaluation of the application, the following factors are being considered: the proper design of the facility whether it may be a laboratory, an exposure area in case of industrial radiography, or the



permanent location or station of an equipment incorporating the radio-isotope; the qualifications and experiences of the proposed user or users; the provision of the proper monitoring instruments and equipment; the availability of supplies and materials for decontamination purposes; and such other requirements which are standards in radiological health and safety.

Qualifications and Training of Individual User or Users.

Most of the applicant-users especially the medical doctors have trained abroad in the safe handling and use of the radioactive materials. Individual user in industry have trained in the company where they obtained their equipment. In addition, these users also participated and completed Training Courses sponsored by the Commission. These courses are specifically designed to inform or complement their knowledge about radioisotope techniques particularly on the radiological health and safety aspects. After they have satisfactorily completed the training, they are issued certificates which may make them eligible to handle and use radioactive materials in their individual establishments.

Life of a License.

Pursuant to the Rules and Regulations on the Acquisition, Possession and Use of Radioactive Materials in the Philippines, the permit or license issued by the Commission has a life of one year, the expiration date is reckoned at the end of the day, in the month and year so stated in the license. During the lifetime of the license, the license or permit holder are subject to the terms and conditions as set forth in the Rules and such

other orders that are issued by the Commission from time to time. Each license or permit holder has the option to ask for renewal and/or amendment of the license or permit, provided that the renewal request is submitted to the Commission through the DNRS within 30-days before the expiration of the license or permit.

Status of Radioactive Materials in the Philippines.

The Commission, through the Department of Nuclear Regulations and Safeguards, have made a running account of all the radioactive materials covered by licenses and permits and possessed and used by license and permit holders in the country. This is accomplished because under the provisions of Republic Act 2067, as amended, and Republic Act 5207, licensee or permit holders have to submit reports (quarterly or annual) to the Commission. Through these submitted reports, monitoring and inventory of radioactive materials is determined. Table V shows the list of licensed radioactive materials and their activities.

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Thanks are also due to Dr. C.R. Aleta, Chief, Regulations and Compliance Division of the Department of Nuclear Regulations and Safeguards, for his support and guidance in the completion of this paper.

References.

1. Republic Act 2067, as amended.
2. Republic Act 5207.
3. Rules and Regulations on the Acquisition, Possession and Use of Radioactive Materials in the Philippines, Official Gazette, Vol. 55, No. 17, April 27, 1959.
4. Radiological Health Handbook, Revised Edition, January 1970.

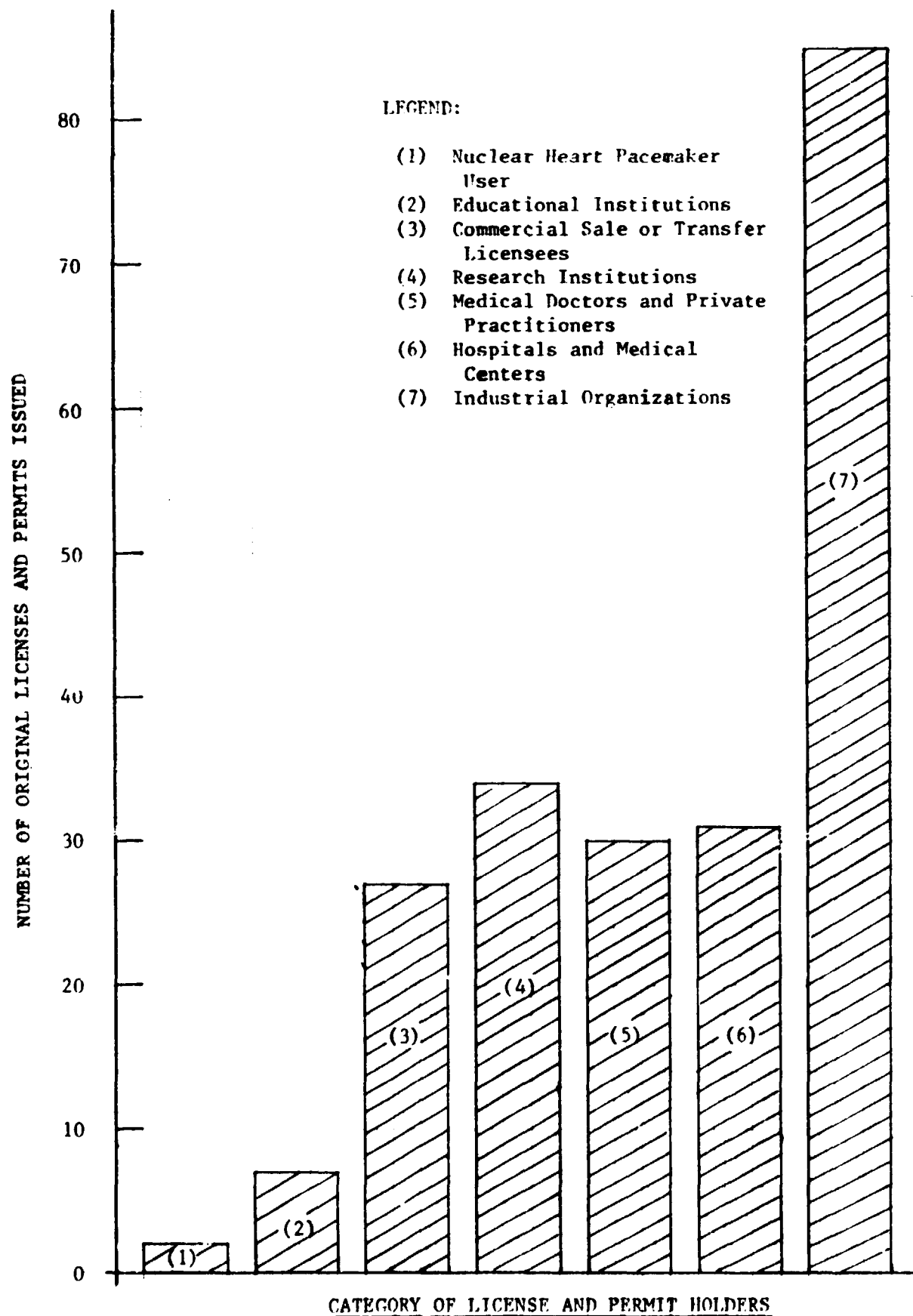


Figure 1 - BREAKDOWN OF ORIGINAL LICENSES AND PERMITS ISSUED BY THE PHILIPPINE ATOMIC ENERGY COMMISSION (As of June 30, 1976)

Table 1. Number of Cancelled Licenses

REASON	NUMBER*	PERCENTAGE DISTRIBUTION
1. Research work of the licensee have been completed.	17	30.36%
2. Licensee has ceased to be engaged in the commercial sale or transfer of the radioactive materials.	9	16.07%
3. License holder is no longer involved in radiation work.	11	19.64%
4. Licensee is now residing or working abroad. Radioactive materials in his possession have been sold or transferred to another licensee.	2	3.57%
5. The original license was issued in the name of the individual working in the institution who have since then applied for a PAEC license. The license issued to the Institution have incorporated the individual as an authorized user.	6	10.71%
6. The company possessing the original license was bought by another and new company has applied and was granted the appropriate license.	2	3.57%
7. Contract to use radioactive materials for projects in the Philippines have been completed. Licensee returned to his country of origin with all his equipment and radioactive materials.	2	3.57%
8. Radioactive materials did not become available after the issuance of a permit to import due to changes in company's management policies. Company subsequently requested cancellation of the permit.	5	8.94%
9. Equipment and radioactive material temporarily stored in the PAEC's Isotope Storage. Licensee request temporary cancellation.	2	3.57%
T o t a l s	56	100.00%

\* As of June 30, 1976.

Table II. Breakdown of Original License  
Issued by the Commission.

CATEGORY	NUMBER OF ORIGINAL LICENSE			PERCENTAGE DISTRIBUTION
	EXISTING*	CANCELLED	TOTAL	
1. Hospital and Medical Centers	30	1	31	14.32%
2. Medical doctors and Private Clinics	22	8	30	13.90%
3. Commercial sales or Transfers	18	9	27	12.50%
4. Research Institutions	17	17	34	15.75%
5. Educational Institutions	6	1	7	3.24%
6. Industrial Organizations	65	20	85	39.36%
7. Nuclear Heart Pacemaker Users	2	0	2	0.93%
<b>T o t a l s</b>	<b>160</b>	<b>56</b>	<b>216</b>	<b>100.00%</b>

\* As of June 30, 1976.

Table III. Classification of Industrial License Holders.

CLASSIFICATION	NUMBER OF ORIGINAL LICENSE			PERCENTAGE DISTRIBUTION
	EXISTING*	CANCELLED	TOTAL	
1. Industrial Radiography and Non-destructive Testing	14	7	21	24.65%
2. Mining Industry	12	3	15	17.63%
3. Textile Manufacturing	4	0	4	4.71%
4. Cement Manufacturing	4	3	7	8.24%
5. Roads and Highways Construction	3	0	3	3.53%
6. Cigar and Cigarette Manufacturing	4	0	4	4.71%
7. Electronic Parts and Components Manufacturing	4	0	4	4.71%
8. Chemicals Manufacturing	5	2	7	8.24%
9. Consumer Products Manufacturing	2	0	2	2.36%
10. Oil Exploration	3	1	4	4.71%
11. Glass Manufacturing	2	2	4	4.71%
12. Oil Refineries	1	1	2	2.36%
13. Steel Manufacturing	2	0	2	2.36%
14. Fertilizer Manufacturing	1	1	2	2.36%
15. Wood and Wood Products Manufacturing	1	0	1	1.18%
16. Tire Manufacturing	1	0	1	1.18%
17. Beer Manufacturing	1	0	1	1.18%
18. Instruments Calibration	1	0	1	1.18%
<b>T o t a l s</b>	<b>65</b>	<b>20</b>	<b>85</b>	<b>100.00%</b>

\* As of June 30, 1976



Table IV. Number of Teletherapy Facilities in the Philippines. \*

LICENSEE	:	TYPE	:	LOCATION
1. Philippine General Hospital	:	Co-60, AECL	:	Manila
2. Philippine General Hospital	:	Cs-137, AECL	:	Manila
3. Ospital Ng Maynila	:	Co-60, Toshiba	:	Manila
4. Chinese General Hospital	:	Co-60, AECL	:	Manila
5. Jose R. Reyes Memorial Hospital	:	Co-60, Shimadzu	:	Manila
6. St. Luke's Hospital	:	Co-60, Keleket	:	Quezon City
7. GSIS Hospital	:	Co-60, AECL	:	Quezon City
8. Veterans Memorial Hospital	:	Co-60, Shimadzu	:	Quezon City
9. Makati Medical Center	:	Co-60, AECL	:	Makati, Rizal
10. Baguio General Hospital **	:	Co-60, Shimadzu	:	Baguio City
11. Southern Islands Hospital	:	Co-60, Toshiba	:	Cebu City
12. Dr. Lydia R. Medalle Medical Center	:	Cs-137, Radio-chemical Centre	:	Cebu City
13. Dr. Daniel Ledesma Medical Center	:	Co-60, Siemens	:	Iloilo City

\* As of June 30, 1976.

\*\* Facility not yet operating.

Table V. Licensed Radioactive Materials and their Activities.\*

RADIONUCLIDE	SYMBOL	TOTAL ACTIVITY
1. Cobalt-60	Co-60	28,650 Curies **
2. Caesium-137	Cs-137	3,650 Curies **
3. Iridium-192	Ir-192	420 Curies
4. Promethium-147	Pr-147	212 Curies
5. Krypton-85	Kr-85	60 Curies
6. Radium-226	Ra-226	11 Curies
7. Americium-Beryllium	Am:Be	6 Curies
8. Strontium-90	Sr-90	3 Curies
9. Mercury-197	Hg-197	2 Curies
10. Iodine-131	I-131	6,276 Millicuries
11. Gold-198	Au-198	2,127 Millicuries
12. Technetium-99m	Tc-99m	1,705 Millicuries
13. Polonium-210	Po-210	1,076 Millicuries
14. Phosphorous-32	P-32	974 Millicuries
15. Iron-59	Fe-59	692 Millicuries
16. Chromium-51	Cr-51	595 Millicuries
17. Indium-113m	In-113m	515 Millicuries
18. Tritium	H-3	427 Millicuries
19. Iodine-125	I-125	309 Millicuries
20. Nickel-65	Ni-65	250 Millicuries
21. Carbon-14	C-14	163 Millicuries
22. Strontium-85	Sr-85	103 Millicuries
23. Sodium-24	Na-24	126 Millicuries
24. Cobalt-57	Co-57	74 Millicuries
25. Sulfur-35	S-35	70 Millicuries
26. Gallium-67	Ga-67	65 Millicuries

\*As of April 30, 1976

\*\*Includes the activities of teletherapy sources.

(Continuation). . .

RADIONUCLIDE	:	SYMBOL	:	TOTAL ACTIVITY
27. Strontium-87	:	Sr-87	:	50 Millicuries
28. Xenon-133	:	Xe-133	:	50 Millicuries
29. Mercury-203	:	Hg-203	:	45 Millicuries
30. Calcium-45	:	Ca-45	:	37 Millicuries
31. Nickel-63	:	Ni-63	:	30 Millicuries
32. Plutonium-238	:	Pu-238	:	30 Millicuries
33. Potassium-45	:	K-45	:	20 Millicuries
34. Potassium-42	:	K-42	:	19 Millicuries
35. Zinc-65	:	Zn-65	:	15 Millicuries
36. Selenium-75	:	Se-75	:	13 Millicuries
37. Manganese-54	:	Mn-54	:	10 Millicuries
38. Rubidium-86	:	Rb-86	:	10 Millicuries
39. Sodium-22	:	Na-22	:	10 Millicuries
40. Bromine-82	:	Br-82	:	8 Millicuries
41. Copper-64	:	Cu-64	:	5 Millicuries
42. Chromium-52	:	Cr-52	:	5 Millicuries
43. Cobalt-58	:	Co-58	:	5 Millicuries
44. Thallium-204	:	Tl-204	:	5 Millicuries
45. Bromine-85	:	Br-85	:	4 Millicuries
46. Iron-55	:	Fe-55	:	2,000 Microcuries
47. Sulfur-38	:	S-38	:	1,000 Microcuries
48. Bismuth-210	:	Bi-210	:	20 Microcuries
49. Strontium-89	:	Sr-89	:	10 Microcuries
50. Chlorine-36	:	Cl-36	:	8 Microcuries
51. Lead-210	:	Pb-210	:	5 Microcuries
52. Promethium-144	:	Pr-144	:	3 Microcuries
53. Thorium-232	:	Th-232	:	2 Microcuries
54. Barium-133	:	Ba-133	:	2 Microcuries
55. Cadmium-109	:	Cd-109	:	1 Microcurie
56. Uranyl Nitrate	:	:	:	38 Pounds
57. Thorium Nitrate	:	:	:	1 Pound
58. Uranyl Acetate	:	:	:	200 Grams