e RADIATION 5 yon URVey ey COMMONWEALTH OF PUERTO RICO NUCLEAR CENTER DEPARTMENT OF HEALTH SECOND REPORT ---Page Break--- ---Page Break--- EVALUATION OF HEALTH HAZARDS DUE TO UNINTENTIONAL IRRADIATION OF THE GONADS DURING ROUTINE ABDOMINAL X-RAY EXAMINATION OF MALE AND FEMALE PATIENTS IN PUERTO RICO. REPORT NUMBER 2 - SOUTHERN REGION MICHAEL GILEADI, MS. — RESEARCH ASSOCIATE PUERTO RICO NUCLEAR CENTER JUNE 1970 ---Page Break--- ---Page Break--- “It has been demonstrated that gonad doses can be reduced very decidedly with improved techniques by a factor of 50 to 100 percent” Report of the United Nations, General Assembly, New York, 1958, ---Page Break--- ---Page Break--- ACKNOWLEDGEMENTS The author wishes to express his appreciation for the assistance in the preparation of this second report to: Dr. Angel A. Colo Obie, Assistant Secretary for Environmental Health and Consumer Protection, for his warm attitude and encouragement in this project; Mr. Modesto Reyes-Reyes, Environmental Health Supervisor, Southern Health District of Puerto Rico, for his devoted and valuable cooperation in collecting certain data; Dr. Ramberto Pérez Ribier, Radiologist; Mrs. Zolla Rosario Iglesias, Chief X-ray Technician; and the Administrative staff of the Ponce District Hospital for their assistance in allowing the author to use their equipment for dose measurement. ---Page Break--- ---Page Break--- TABLE OF CONTENTS

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Collaboration between the Department of Health and the Puerto Rico Nuclear Center will be of great benefit to the future population, since the Department of Health recognizes the important role

of radiation for the well-being of the population of the land, present and future generations. Protection for this project was approved to survey Puerto Rico's dental units. This includes actions in cooperation with the School of Dentistry and the University of Toronto. It is hoped that its results will complete the survey of the island’s diagnostic X-ray units.

Dr. Ernesto Colén Yordén, M.D.
Secretary of Health

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SUMMARY

Per capita annual gonad doses, as well as genetically significant doses associated with a selected group of abdominal and thoracic X-ray diagnostics in the Southern Region of Puerto Rico during 1968, have been determined and are reported herewith. Similar indicators referring to the Western Region of Puerto Rico have been updated in order to make comparisons more meaningful. Some of the most important results of the survey are summarized below and compared with available 1967 data.

REGION AND YEAR OF REFERENCE
Southern Region 1965 Western Region 1968 Western Region 1967
Population: 498,500 | Population: 420,200 | Population: 438,400
Mean gonadal dose per abdominal X-ray: 443.6 mrad | 424.8 mrad | 422.8 mrad
Mean gonadal dose per thoracic X-ray: 1.08 mrad | 1.00 mrad

These results indicate that, generally speaking, the genetic hazard due to thoracic examinations is negligible as compared to the hazard caused by abdominal X-ray diagnostics. The results point to the imperative need for accurate collimation and shielding to reduce the gonadal dose to the minimum compatible with reliable diagnosis.

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Further relevant data and results are enumerated below.
[REGION AND YEAR OF REFERENCE]

Pop. 498,500 | Pop. 420,200 ‘Number of diagnostic X-ray units (excluding dental X-ray units) and 48,586 55.68 ‘Total number of clinical and diagnostic examinations 108,576 97,258 (number of X-ray diagnostic exam into inspections rosso 181188 Total number of X-ray examinations per capita? Population per ray with 387 Number of X-ray examinations per 100 patients ua aan Per capita annual gonadal dose (lead) 436 964 While in the previous report the dose evaluation was based on phantom measurements only, dose determination in the Southern Region, 1968, included both measurements using phantom, and measurements in vivo. This provides a more realistic evaluation than one based on phantom measurements only GSD evaluations are—to the author's knowledge—the first ones made in Puerto Rico. ‘The expected number of future offspring per parent by age and sex groups has been evaluated specially for this purpose, using data provided by the Division of Vital Statistics of the Department of Health, P ‘The status of X-ray technicians (operators) in Puerto Rico and its relevance to the amount of radiation unintentionally received by the patients is discussed in the appendix. ---Page Break--- score, “The scope of the present report

has been extended partial report ‘The genetically significant dose is an important consideration since it is a quantitative parameter indicative of radiation hazards The significance of the measurement is further significant improvement To obtain more meaningful value of the genetically significant dose doses associated with thoracic examinations have been reduced “To implement the scope of work described above, it was never 1). Collect the relevant statistical data, including the number and characteristics of X-ray units and their characteristic parameters, the number of X-ray examinations performed by each unit during provide time review by type of examination, age and sex of patient, geographic location. 2) Measure the unintentional irradiation doses associated with the X-ray examinations considered, taking into account the differences in the use of different X-ray units.

Collimation and/or filtration may well differ depending on the technique of positioning. Establish correlation of dose data measured in situ on one hand and the Rana Phantom on the other. Several popular models of X-ray tubes were used in this procedure in order to assess the relevance of hazards. Evaluate from the measured data the average annual per capita gonadal dose and the genetically significant dose using demographic data from the Government of Puerto Rico.

In order to execute each of the above-mentioned applications, appropriate procedures were developed and followed.

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COLLECTION AND ANALYSIS OF STATISTICAL DATA Southern Region, Puerto Rico - 1968

Statistical data was collected and analyzed in the Southern Region of Puerto Rico in a similar manner as in the Western Region, following the Planning Board Systems. Table 1 shows the municipalities of the Southern Region and their respective populations. Addresses of all medical facilities were taken from the Medical Directory of Puerto Rico 1968. The required data were collected by sending a detailed questionnaire and cover letter to each medical facility and private medical office in the Southern Region that operated two or more diagnostic X-ray units. The improved questionnaires are part of this report. The new questionnaires facilitate automatic data processing, as planned for future surveys. The presence of the Health Department among the sponsoring agencies, and the active support of the Project by the Deputy Secretary of Health, improved the response of the private medical offices significantly. Long-distance telephone calls and personal visits were nevertheless necessary to complete the required data. Some of the difficulties encountered in data collection stemmed from the fact that the Southern Region of Puerto Rico is larger in area and more mountainous than the other regions. A COPY of the sample questionnaire along with a copy of the cover letter sent by the Subsecretary of Health is included in this report. Unlike the procedure followed.

In the previous report, diagnostic chest X-rays were included in the present survey in order to make the average gonadal dose, as well as the ‘genetically significant dose values, more meaningful. Those are of Undersecretary of Health Sr. Carlos Nater, and a sample questionnaire are shown on the following pages. ---Page Break--- DEPARTAMENTO DE SALUD SAN JUAN, PUERTO RICO, 00908 2h de junto de 1970 1 Médicos de Hospitales Públicos y Privados, Médicos en Práctica Privada y Radiólogos de Cartos 2, Mater, HD. EX Subsecretario de Salud Asunto + ‘Encuesta sobre radiación y evaluación de la radiación de los gónados durante los exámenes de rutina de Rayos X en los hombres y las mujeres de Puerto Rico. El Departamento de Salud, conjuntamente

con el Centro Nuclear de la Universidad de Puerto Rico, perteneciente a la Contain de Energía Atómica de los Estados Unidos, está realizando un estudio minucioso de cosas. Las facilidades de Rayos X en Puerto Rico están realizando una encuesta y una evaluación de los posibles peligros no intencionados que pudieran tener los diferentes equipos de Rayos X existentes en la Isla. Esta encuesta está realizada por el Sr. Michael Gileadt, M.S., Científico Asociado del Centro Nuclear de Puerto Rico, y sus asistentes, quienes les visitarán previamente para explicarles cómo se conducirá dicha investigación. En las Regiones Oeste y Sur de Puerto Rico se hizo un estudio estatal que fue de gran provecho para todas las instituciones y médicos privados, ya que se pudo identificar y corregir a tiempo pequeños defectos en los equipos que ofrecen algún peligro de radiación no intencionada. Al mismo tiempo se pudo discernir con gran acierto qué medidas tomar para evitar radiación innecesaria a los gónados de ambos sexos. Esperamos que se le ofrezca al señor Gileadt la mayor cooperación y toda la información necesaria para que esta investigación científica y constructiva tenga el mejor de los méritos. ---Page Break--- X-ray RADIATION SURVEY ~ 1968 — QUESTIONNAIRE — No.1 ven) Sia wnweR oF Boe Oi IT a cio

cio coc wnomben oF aurearenrs: COO CO coo TOM. muMBER OF paris COO OOo co) cod cui omy qoug mete rntont_ O18 20 ara ooo cu) O11 am mo a ---Page Break--- XRAY RADIATION SURVEY~1968 - QUESTIONNARE- 2 ---Page Break--- X-RAY RADATION SURVEY RapooRA PIC)UESTONNARE = 3 oor ysemial MBER OF MABOERAPWE MACHINE Oooo omowaen oF Tums DO ower CO foricrmaron wi AL om CO werent CT] AVERAGE WUMBER OF PATIENTS PEM WEEK coo avensee NUMMER OF EXPOSURES PER WEEK od CTEWPERATURE OF DEVELOPER: oo docvecorae nie Gare) co ---Page Break--- XRAY RADIATION SURVEY 1968 QUESTIONNAIRE 4 Fuvonoscorc ootctr QO Tanocoren wees PLO CO ELT To ‘SARUM ENEMA, ITT LO uy ---Page Break--- ---Page Break--- SOUTHERN REGION, PUERTO RICO—I968 ‘The Southern Region includes the southern coast of the Island, with sixteen municipal ties and population of 493,500 (1968). Ponce, the most important city ofthe Region, preceded only by San Juan, isa dynamic city with a promising economic, cultural and political future. Heavy industry is being d- veloped in his area, There isa private university, three schools of nursing and the Soutbera ‘Tabslating and Technology College which offers an X-ray Technicians Course. Ponce has « medical center with a district hospital, two private hospitals, two clinics and thtee ant-tbercaloss facilities (Hospital Anti-Tubercafoss, Pubic Health Unit and the T. B. Center), There are five munieipal hospitals in the area, en Health Centers and two private hospitals, ---Page Break--- Table 1-8 Table 2-8, Table 3-8: ‘Table 8: ‘Table 5-8: ‘Table 6-5: ‘Table 7-8: Table 8S: ‘Table 9-8: ‘Table 10-8: ‘Table 11-8 ‘Table 12-8 ‘Table 13-8 LIST OF TABLES Municipalities f the Southern Reon of Puerto Rico and their Populations 1968, Distribution of Diagnostic X-Ray Units by Madical Facility. by Geographic Location sid Poplation per X-Ray Unit Southern Region, Puerto Rico 908 al Number of X-Ray Eaamations n Public inaittions, Total Number Of Patients and Number of X-Ray Examinations per 100 Patients, Southern Region, Puerto Rico~1968. Datnbution of

Diagnostic X-Ray Units by Medical Facility and by Manufacturer. Southern Region, Puerto Rico-1968. Census of Diagnostic X-Ray Units. Southern Region, Puerto Rico-1968. [Number of Abdominal X-Ray Diagnostic Examinations by Medical Facility, by the Type of Examination and by Sex. Southern Region, Puerto Rico-1968. Number of Diagnostic Thoracic X-Ray Examinations by Geographic Location, Medical Facility and Sex. Southern Region, Puerto Rico-1968. Total Number of Diagnostic Thoracic and Abdominal X-Ray Examinations. Southern Region, Puerto Rico-1968. Number of Abdominal X-Ray Examinations by Type of Facility and by Type of Examination Southern Region, Puerto Rico-1968. Number of Films Exposed (Exposures) in Abdominal Radiographic Examinations, by Type of Facility and by Type of Examination, Southern Region,

Puerto Rico-1968. Number of Films Exposed (Exposures) Radiographic Examinations of the Abdomen and Thorax, by Type of Facility. Southern Region, Puerto Rico-1968. Number of Exposed Films (Exposures) of Abdomen and Thorax X-Ray Examinations, by Type of Examination and by Sex. Southern Region, Puerto Rico 1968. Supervision by Radiologists, Southern Region, Puerto Rico-1968. 12 ---Page Break--- ots OW3Nd *HLWSH JO LNANL MEO *@961‘LNOdIH SOUSUYLS TVLIA TVANNY 3HL Wows G3L0NO JUV viva 3A08Y SHA ~1 00 S86 % NOIOIY NYIHINOS NCLINGOS WiOL ‘oonwa ven T3eyS! vANYS SUNS 30Nod sv7anya4 svriiva osyneviN zya yy vanier wrawaen ywvaeno voINvnO ‘owyoo once smunneay NoLv Inada SSurwarINnn 2961 NOUW dod MIBHL ONY OOH OLMING 40 NOIDZ NYSHINOS HL 40 SaUMTMBONNW ' s-1 Fav ---Page Break--- costes « Twi01 zwi0 weve 2 er) zw wwne £350 M1 JON AnMIUMOUNEL) wean39 HLTH 001 ‘ z s301440 auvaina ooz't BUNS “LW vanave (000%! (000%! . ‘ssows0 aivaiva ynimeavas __ wines Miwa | 2 les 201 ‘I ° Jwio vaVATNO ' ‘Spoiai0 sivas z ‘ysou TINS WLIsSOH yweavng a é AGUNG MOWSK | oe 0821 ni TWildsOH vowwoe WHI ' = “vildson_WaroMrn, veweng or ooz's2 © Twi0L oMVOD a Spo SvAras 2 YGIN3D ROWE onvoo ar . - TWONNN “WASH Douay 02's « SUI3NaY) “TulesoH “ 08 ‘er 1 szus0 avin

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Respect to the Number of Population. Southern Region, Puerto Rico - 1968, 43 ---Page Break--- |. re3s 390 904 con sx SESE asus wc Hum (8301830 SUNWd SNVIDISAHE C-sonno, canon estates Ceres 961 cow aLasnd 40 NOESY NUBKuNOS SUN Aad LIM G2daNO3 SSUIIOWS TWoE|N ao MBUNEWLSIO WoIKsNEEOIS s-1 suns ---Page Break--- sryuulsson #1. SHE SY UN AMEX NYS BAL CaSO ¥BANGD “BL 3H ZONDA JO NMOL IAL NI Onsrwuason mw Sunn 896-0014 O1NBNG

40 NOIORH NUGHINOS NI_SLINN OUSONONO AMH-X 40 NOUNERISC s2 anol ---Page Break--- “$3010 INI NI SLNN AVY-X 3OMONI JON $300 3uNDIs SIL [a SS SS feed ee Mee (HE HED i t 1 fi (82) ceo) Ul TWINIUNOD — VROGY —SNBNIS NBL avONNLS Peed) 8 wean o aicauous 3snoHONLLSM oz (2108) be. of wana ov "9961-091 OLN3Nd NOISY _NUBHLNOS UBINLOVINNYN AS SLINN AY-K JO NOLLNERLSIO see aunold ---Page Break--- Figure 4—s VARIATION OF POPULATION AND NUMBER OF X-RAY DIAGNOSTIC UNITS IN PUBLIC AND PRIVATE MEDICAL INSTITUTIONS, SOUTHERN REGION PUERTO RICO ~ 1940 968, 90 80 447,200, br 50. 429,600 28 30. 20 376,600 1940 1950 1960 968 Gece Hart ---Page Break--- Figure 5-5 NUMBER OF UNITS INSTITUTIONS AND POPULATION X-Ray OF VARIATION Tubes Pusuic DIAGNOSTIC " MEDICAL AND PRIVATE 3 ° i 5 4 z | 3 2t g = 3 ax g . 3 e PR RE 447,200 1960 Nor SOUTHERN —REGION, 1940 1350 THIS FIGURE OES DENTAL OFFICES. ° ---Page Break--- FIGURE 6-8 PERCENT DISTRIBUTION OF RADIOGRAPHIC EXAMINATIONS ‘BY BODY AREA IN PUBLIC AND PRIVATE MEDICAL INSTITUTIONS SOUTHERN REGION PUERTO RICO — 1968, THORACIC 48.5% (105, 576) Lower ABOMINAL, 21.7% 2s 22) (47,440) (22,148) The percent distribution of the 217.73 radiographic examinations by body area in ‘the Southern Region is shown in Figure 68 About half of all X-ray examinations performed in this region were related to the thorax, ‘Abdominal X-ray examinations represented about 22% of the total X-ray examinations {EEO Toe wa iy hpher rrr of lower abdominal examinations (25,292) 7 ---Page Break--- Figure 7-5 PERCENT DISTRIBUTION OF DIAGNOSTIC X-RAY EXAMINATIONS IN MEDICAL INSTITUTIONS BY TYPE OF FACILITY, SOUTHERN REGION OF PUERTO RICO - 1968, wosprTacs

33.19% | mae68) PRIVATE OFFICES 21.48% (46,606) HEALTH CENTERS PUBLIC HEALTH UNITS FONDO DEL SEGURO 33.58% (73,129) Figure 78 shows that the rate of X-ray examination per 100 population in the region of Ponce. Much has been said about the highest economic and social status in the area. The data showed that in the eastern region, those who have higher education have more medical X-ray examinations per 100 population per year than those who live in lower educational and income levels. These differences are related to economic and social factors, which influence medical care. Persons with higher education tend to have greater access to X-ray tests than those of lower educational and income levels. ---Page Break --- 896I— COW O1NSNd "NOISY NEIGHBORS ‘ALMOST 30 3¢AL ONLY NOUWINDS “WLOL AB SLINN AYU-X 40 NOUNGWWLSIO IN3OH3d S-6 3unold ---Page Break --- 008’ —o02’ez NOL INGO __ ‘oon. ovo © 00) g fei 5 of P ovs4 es 3 re g “how os § 2s A i on og 9961-0918 O4N3Ne NOISY NEIGHBORS NOUWINdOd 40 ¥IBNNN 3H OL 4O3dSH HLM SSNOUWNINXS HOI-X OUSONEVId 40 ive WANNY 3HL 40 NOUN@AISIO oMavH0D S-8 3Hnols ---Page Break --- DOSE MEASUREMENTS "Medical radiation equipment is the most important electronic product with regard to population exposure; any radiation imparted to the gonads constitutes a potential health hazard not only to the individual but also to his or her future offspring via the radiated genetic material that may alter the genetic code transmitted from parent to offspring and may cause changes or mutations that are seldom benign. In order to express the health hazard associated with each individual diagnostic procedure in a quantitative fashion, three types of characteristic indicators are generally used: (1) The mean gonadal dose per examination of a certain type, (2) The per capita per annum gonadal dose as referred to a suitably defined population, (3) The genetically significant dose. Reliable and accurate dosimetric measurements are indispensable for the evaluation of these indicators. For this reason, no effort was spared to make the dose measurements as accurate and reproducible as possible. The

Majority of the dosimetric measurements were carried out in the District Hospital of Ponce using a

Picker 200 MA X-ray unit with PX:1DA tubes as the irradiation source. This unit has a filtration equivalent to 5 mm of aluminum and a half-value layer of 4 mm aluminum, corresponding to an effective energy of 87 keV at 16 kVp, tube voltage typically used in abdominal X-ray diagnostics. The unit is equipped with a variable collimator. Figures 1 DS and 2 DS contain the data and demonstrate the method used to determine the half-value layer of two different sources. The instrumentation used for dose measurements included the following: (1) Victoreen Model 227, bakelite-walled ionization chamber, 1000 mR range; (2) Victoreen Model 228, bakelite-walled ionization chamber, 6000 mR range. All Victoreen ion chambers were calibrated by the Victoreen Company using intercomparison with instruments whose calibrations are traceable to the US National Bureau of Standards and their accuracy is within ±3%. A copy of the calibration certificate containing the approximate correction factors is enclosed with this report (see pp. 6844) and covers correction factor vs. kVp as plotted in Figure 3 DS. (3) Thermoluminescent dosimeters (TLD) manufactured by Conrad, model No. P27, containing 43 mg of powdered LiF encapsulated in a polyethylene capsule, having a diameter of 5 mm and a length of 17 mm. These dosimeters were pre-calibrated by the company and equipped with low energy filters. Intercalation curves relating LiF-TLD readings with Victoreen readings are part of this report (see Tables 1 DS, 2 DS, and Figures 4 DS and 5 DS). (4) Conrad Thermoluminescence Dosimetry System Model 100 B Readout Instrument for reading the irradiated LiF-TLD dosimeters. (Radiation-sensitive film package, Model Du Pont 5x-249126 (high sensitivity). (5) Sensitometer, Model Macbeth Anseo (property of the Health Physics Division, Brookhaven National Laboratory). Intercalibration curves of film and Victoreen readings are part of this report (see Table 3 DS, Figures 6 DS).

7 D8, pp. 67-68 (fd datasheets pp. 111-114) (@) Rando-Phantom, Model Ran-100, manufactured by Macklett Laboratory, Inc. was used in lieu of the patient, with a radioabsorptivity equivalent to human tissues, simulating cross-sectional views and contents typical of the human body. “The soft tissues of the phantom were molded of thermosetting isocyanate rubber, a material both physically and chemically tailored to the desired values of Z and specific gravity. In order to be able to measure the ovarian doses, the anatomic location of the ovaries was determined by a radiologist and a slot accommodating the thickness of a Victoreen 228 ion chamber was cut into the appropriate section (section No. 90 of the phantom). Table 4 D8 contains data concerning exposures at the location of the ovaries at a depth of 12.5 with the Rando Phantom. The intercalibration procedure was carried out by positioning the Rando-Phantom in such a manner that it should closely simulate the positioning of the patient in an actual diagnostic situation. With this positioning, the gonadal exposure was measured using a Victoreen chamber and next under identical conditions with a LiF-TLD capsule. Results of these measurements are reported in Table 5 D8 and Figure 8 D8. Figure 8 D8 indicates that the relationship between Victoreen and corresponding TLD-LiF reading is linear within the range of slight experimental errors. In vivo measurements were performed on male patients in the Ponce District Hospital, using TLD-LiF dosimeters to determine testicular in vivo exposures associated with each of the considered abdominal X-ray diagnostic examinations. The results of these in vivo measurements are reported in Table 8 D8 and are also compared to exposures on the Rando Phantom obtained under identical radiological conditions (KVP, MAS, TFD, etc.) measured first with a TLD-LiF dosimeter, then with a Victoreen chamber. Table 6 D8 shows very satisfactory agreement of in vivo and in phantom readings, thus reestablishing the reliability of the Rando-Phantom as a research tool and also establishing confidence in the

validity of those in phantom tradition data (ovaries exposure) that are rather ‘complicated to measure in vivo. Figure 9 D'S demonstrates this correlation between in vivo fh in phantom

readings. Units recommended by the International Commission on Radiological Units and Measurement (published in N.B.S. Handbook No. 85, 1964) are used throughout this report. Rad for absorbed dose, Roentgen for exposure dose. Absorbed dose is dependent upon the mass absorption coefficient of the absorbing medium, which in turn is energy dependent. Using the customary spectral composition of the diagnostic X-ray beam in the 50-100 KEV region, one Roentgen exposure dose in air corresponds to 877 rads of absorbed dose in air. ---Page Break--- (One Roentgen exposure dose in soft tissue, under the same stipulations, corresponds to 92 rads of absorbed dose in soft tissue. Table 7 contains the mean gonadal doses by type of examination. Each value was measured several times in order to minimize experimental error. A Rando-Phantom was used in lieu of the patient. Victoreen chamber was used to determine the exposures and the results were converted into milirads by multiplying the corrected readings by the stable absorption factor (92). Table 8 D-S serves as a worksheet to compute the per capita per exam doses by sex as referred to the total population of the Southern Region, 1968 reported in Table 9 DS. The method of calculation is given herewith. In order to determine the corresponding gonadal doses (absorbed) one must multiply the exposure doses (mR) by the factor 82 (the proper conversion factor for soft tissues, as explained previously). The first column of Table 8 D'S presents the Mean Gonadal Exposure Doses by Sex and by Type of Examination. The second column of these Tables contains the Mean Absorption Doses obtained by multiplying the first column (Exposure Doses) by the conversion factor 92, as given in NBS. No. 85, 1964. The third column of the Tables contains the Total Number of Examinations by Type of Examination and by Sex. Each entry in the fourth

column is computed by multiplying the corresponding entry of columns two and three, resulting in the Global Gonadal Absorption Dose by Sex and by ‘Type of Examination. The Total and Grand Total column contain the corresponding totals of Examinations and Global Gonadal Absorption Doses. The second figure in this sum gives the Mean Gonadal Absorption Dose by Sex and the Average, computed by dividing the corresponding entries of column four by those of column three. the Average Gonadal Dose weighted by the corresponding number of cases. The first figure of the Total column is obtained by dividing the corresponding second column entry by 92. Using the Global Irradiation Dose in Table 8 D-S with the proper population figures, the per capita annual average radiation dose due to all the generally considered abdominal and thoracic diagnostic X-ray examinations in the Southern Region, Puerto Rico-1968 is computed thus: 22.7 mads per person per year for males, 86.4 mads per person per year for females, and 43.6 mads per person per year for both sexes. Table 10 D'S contains the calculation of the mean gonadal doses by sex and by type of thoracic examination and the mean gonadal dose due to all thoracic examinations computed with the method described above. It is interesting to observe that although the number of X-ray examinations per 100 patients is higher in the Southern Region than the corresponding figure in the Western Region 1967/8 (140.6 vs. 84.1), the per capita gonadal dose in the SR in 1968 is lower than the corresponding figure in the W-R in 1968 (43.6 vs 56.4). This may very well be due to technically sounder practices in the SR, associated presumably with the general higher industrial and technical level of that geographic region. As an illustration of what is meant by “technically sounder practices," it is worthwhile to point out that sixty (60.2%) of the thirty diagnostic X-ray units in use in the Southern Region-1968 had variable collimators while only seventeen (27.7%) of the seventy-eight diagnostic X-ray units in the 88.

---Page Break--- Wester Regio 1068 had variable collimators. The importance of good collimation in relation to the unintentional gonadal dose is demonstrated in Figure 10 D'S, which compares the anatomical regions of the body exposed to radiation during thoracical diagnostics performed with

(1) a variable collimator, (2) a cone, (3) no collimation. The thoracic examination formed a large part (40-50%) of all diagnostic radiology in the Southern Region in 1968, though the gonad dose was only 1-2 mGy in the average chest diagnostic X-ray examination. Certain radiological practices designed to save time for the radiologist may have an adverse effect on the gonadal dose. It was observed that certain institutions practice the following routine in the "gastrointestinal series." After the patient swallows the barium, 5-6 exposures of the 14 by 17 inch film are made at prescribed intervals by the X-ray technicians. The films are then interpreted by a radiologist. In this procedure, the tests are almost always in the primary beam, resulting in a testicular dose of approximately 1500 mGy per examination, whereas the testicular dose associated with the "gastrointestinal series" routine performed by spot film techniques is only about 176.6 mGy (see Table 7 SD). This example should be indicative of how significant sound radiological practices are in keeping the unintentional gonadal doses as low as possible. It may be concluded then, that since the unintentional gonadal doses depend upon a series of radiological parameters such as beam quality, collimation, direct testicular shielding, filtration, positioning, etc., those parameters require careful evaluation in each case by a radiologist in order to keep the unintentional gonadal dose as small as possible without interfering with the quality of the diagnostic information required. Optimizing all parameters with this performance index in mind is the declared purpose of every professional involved in the complex field of radiation protection. ---Page Break--- Figure 1 Ds: Figure 2S: Figure 3 DS: Figure 4 DS: Figure 5 DS: Figure 6

DS: Figure 7 DS: Figure 8 DS: Figure 9 DS: Figure 10 DS: LIST OF FIGURES. Determination of Half Value Layer in the most common X-ray unit, Southern Region, Puerto Rico-1968, Determination of Half Value Layer, by graphical method, ‘transmitted radiation vs. absorber thickness ‘Correction factor of Victoreen 227 and 228 chambers, LIF-TLD powder and Victoreen 228 ion chamber intercalibration curves (Ref. Table 15) LIF-TLD powder and Victoreen 227 intercalibration curve (Ref. Table 205), Indirect beam exposures as measured by Victoreen 227 chamber and by relative optical density of DuPont SX249-135A film vs. voltage applied 20cm caudal from central beam incidence. Indirect beam exposures as measured by Victoreen 221 chamber and by relative optical density of DuPont SX249-135A film vs. voltage applied 20cm caudal from central beam incidence. [LIF-TLD reading vs. Victoreen reading, radiation simultaneous and under clinical conditions (A) Correlation of in vivo and in phantom testicular exposures (B) Measured in vivo count vs. LAF phantom count, Influence of collimation techniques on the body area exposed to direct radiation, and as a consequence on the gonadal dose received by the patient during thoracic X-ray diagnosis. ---Page Break--- FIGURE 108 DETERMINATION OF HALF VALUE LAYER IN THE MOST COMMON X-RAY UNITS. SOUTHERN REGION PICKER-300_TEMPERATURE @.€.-200_TEMPERATURE 71°F o— 442. e588 o5—s00 95340 (362 t=—310 passes ls 280 2—305 2—260 25290 3—260 3.3240 (3200 PICKER-300 6986173 Ogden 2.7 & density of AL. TOTAL MASS AL. COEFFICIENT TOTAL MASS AL. COEFFICIENT Most8Bem scores 2g FEVER: 37 KEV. EVER 34 9KEV. 1) DISTANCE — 72cm (TARGET —VICTOREEN DISTANCE) 2) DISTANCE TO — 36cm (TARGET—-FILTER DISTANCE) 3) MEASUREMENTS WERE MADE AT 71°F (22°C)—, THEREFORE NO TEMPERATURE CORRECTION WAS MADE. 4) VICTOREEN CHAMBER-227 DOOR WAS USED TO MEASURE EXPOSURE. ---Page Break--- FIGURE 208 DETERMINATION OF HALF VALUE LAYER BY GRAPHICAL METHOD TRANSMITTED RADIATION VS. ABSORBER THICKNESS: Sh ieco PKER-300 VARIABLE COLLIMATOR 1 a | GE.— 200 VEX COLLIMATOR Laseo PreKER-

300 ABSORBER — THIORNESS ---Page Break--- SLL See “| yms005 Kv 822 —waRWO NARYOLIIA HO 4A So ous NOLL 3ub9 OLD NOU AAO: woudes nowozeMco "SUIBMYHO 822

ONY L22—NIRYOIDIA 40 HOLA NOILD34UOD sof 3un014 ---Page Break--- Calibration Report to the Directors of Brest Rica ue egies # A/SEOE Sovak 025% 51 142 Mo TECHNIQUE aac aoa] Sern ke o oo ® o . ® for Wigh Prong Chsmters ah Probe, Na Batra Care . “Rca cate mans Suen vgn sa Soe or pa onrae cataset ys Late — Come : Perm tube ---Page Break--- to Clarification of Parla Rede, sae MAY _7 1358 seanerS Ysa me_aartssas Geng oray Tehasaee Lignrty riteerd soray Btecent sates = ota ie io ewe) ae 3 e 07 6s 3.0 ae ° ery Fas Vive 10 1.05, a 20 wo a0 3.25 am a2 “entciniy oy) w a2 20 oe 50.0 ---Page Break--- FIGURE 4 05 LIF-TLD POWDER AND VCTOREEN 228 JON CHAMEER wTER— MATION CURVES (REF, TABLE 108) y LiP-TLO README 6,000. source ~6.¢.-200 woo S00 800 sooo 63 VCTOREEN READING mR 7.000 ---Page Break--- 800 600. 400 200: FIGURE 50-S LIF-TLD POWDER AND VCTOREEN-227 INTERCALIBRATION CURVE (REF TABLE 20S) g a 2 . 200. «300400 800 VICTOREEN READING ~ mR ---Page Break--- EXPERIMENTAL WORK SHEET Distetee Hoepitat expeRIMENTAL FM FORM. GTLEOE saron no. $219, Fosse, Fm ype um PO 5249-1954 are__1/5/90 - rc 1 FIT ERS 7 1 |e) OFM wiNoow | ENA conpitions | o Al tts pe | oF won| (75 fle | EXPOSURE “teaiect team_| Picker 90 EMARKS: suctground fon van subtracted at the tine of road absoluce densities. S35esenaitive flim, “1290clasenaitive fh ‘Tbsratory, Menten Phynien Divisions {ALL denaieios are Sroothaven Naclonal ---Page Break--- EXPERIMENTAL WORK SHEET exPEAMMENTAL FM FOR“. GTLEAOT____ ware No. S212, Fomees FuRs roe rum _DU_PORT $4249-135A pare__/5/70, 10 [__rrerens war conoitions = Trac per oF ---Page Break--- FIGURE 80s LIE-TLD REAONG VS. VCTOREEN READINGS, RADIATION SOAATANEOUS AND WNDER IDENTICAL CONDITIONS. JconnesPonons r= TED READINGS 2,000. 14300 4 TESTCAL, MEASUREMENTS. 0 OVARIAL MEASUREMENTS. 60 ‘590 600 700 800 200 1,800 \VCTOREEN READINGS WA ---Page Break--- rere 905 @comesron of 0 vo sow

PHAON TESTON.AR see @unso vex w wo cowT vs LF pavton cout 8 : ---Page Break--- YOY SADLNINES He 1st 34k NO CNR 32 OTIS 40 NoULANS INOS OW NOMURA" SNE 40 NGAGE, Osun Tou ML NO 035¥6; © OsoLeNOHO AEX TWOWONL OMEN NSLS BL AB GBNIDIY BOO "WorNOD BAL No HAEINIOD Y Se OW nouns 19380 01 a35003 VINT—ACOR BALD SAPENAORL NOMWATTCO. 40 198-3 S901 anos ---Page Break--- Fable 1 Ds Hate 2 bs Late Bs Tse 1 Te 8 Ds Tate 6 DS: Fahte7 bs bate 9 1s LIST OF TABLES: ‘UD pow and Vietoreen 228 ionchamberintecalibration dita Southeen Kegion, Puerto Rio, LIP-TLD powder and Victoreen 227 lonchamberinterealtetion dat, Southeen Keon, Puerto Rio. Du Pont SX210 1954 fm dosimeters ad Vietorson 227 ionchambo Intercalation data, Southern Kegon, Purr Hie xposure at depth oF 12. em an the phantom, a oration of the ove Comparison of testial and ovarial exposures per examination at measured hy Vietoreen 228 (IR) and by TLD-LAP detewter: ong Preker 300 Xr: init and Rando Phottom, Souther Region, Puerta Rico 1968, CCormparison of vivo and in phantom testicular expstes by type « saminaion. Svathern Regn, Puerto Rico-1968 Moan yraal oe per Xray examination by type ot examination and ekee. Sotheon Region, Puerto Rico-1 968, ‘Youn ont dose per patient da to each thoraceul Nay examination, Southern Kegon, Puerto Rico-1968, ‘ompotation of the mean per capt gonadal dose sh to 3 selected sup wetially hazardous sbdomanal diagnostic ray examination, Siither igh Puerto Rigo: 968 Ye eapita per annum mean gonadal dose due tall eooetically haarehage atom nd horace X-ey exominations. Srutiers pion, Puerto Rien 1968 2 ---Page Break--- sporsusagns worizesie> pmestord 5 wt 7 oot ‘ep wyengo 2 pos s2anos oxee 0 ---Page Break--- <pergesngns wora9e2s09 punostheg es 296 os oer 06 ss se sor ory 8 ss 599 ore oe oz w ¥ amsoaxa oma TO) \VaVa KOLAVUBITVONALNI ASGHYHONOT (Z2-NIGWOIOIA ONY WIOHOM GUL-&¥7 s-o zm ---Page Break--- z0°0 seo rset e60"r oe 0% ca0°0 sso 90 ert ow oe rorre oo wore ort oot ow sre sto ven sort sat » ame worReaRTTS LTA AO SWDOETFS serep wreago 02 poem

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ottspring (referred toa

given population) due to intentional gonadal radiation of the parent generation “The formula used is “water >), (Ponaie_ oso = “fl 5) = Al a) ---Page Break--- ns ones to perform the calculation, Table 2. GSD was first compiled to compute the ‘number of examinations performed in the Southern Region of Puerto Rico since 1688 by types and by type of examination. Next, work was set up for each type of examination, a sample of which is attached to this report. This contains the NI values and gonadal dose values which correspond to the type of examination. For example, the product of the list and fifth column entries was entered into the seventh column (Ni, Dim, Pin) and the product to be calculated and saved (Ni, Di, Pf) was entered into the eighth column. The sum of the seventh and eighth columns gives 2 (sim Dim Pim + Nire DEE). This was divided by NP, which is the overall sum of products formed from the population figure in the corresponding age group by the actual number of expected children. The GSD is the quotient of those two numbers. Table 5. GSD estimates of GSD values by sex and type of examination as well as total GSD values by the total number of examinations considered in the report. Among all types of diagnostic X-ray examinations considered, the highest values are associated with Lumbar Spine, VP, and Gastrointestinal Series. Except for examinations involving the pelvic region (which may have the testes in the direct beam), female GSD values are higher than male GSD values. “The genetically significant dose in 1965 in Puerto Rico's Southern Region is lower than the values reported for the USA (1964), Sweden (1955), and Japan (1960). The number of diagnostic X-ray examinations of all kinds per 100 population is 11, second only to the USA (1968) which had 83. ---Page Break--- Table 1 GSD: Table 2 GSD: Table 3 GSD: Table 4 GSD: Table 6 GSD: LIST OF TABLES: Number of thoracic diagnostic X-ray examinations in the reproductive age (15-44) by geographic location, by medical facility, and by sex Southern Region, Puerto Rico-1968. Number of abdominal diagnostic X-ray examinations by type of examination, age, and sex.

Southern Region, Puerto Rico - 1968, ‘Number of thoracic diagnostic X-ray examinations by type of examination, age, and sex. Southern Region, Puerto Rico 1968. Genetically significant doses in millirads by type of examination, age, and sex. Southern Region, Puerto Rico 1968. ‘Comparison of reported annual genetically significant dose from diagnostic radiology (selected countries). 85 ---Page Break--- ---Page Break--- seroneg cos) 1mm ---Page Break--- corso) 1 new, ---Page Break--- TABLE 2 (6.5.0.) NUMBER OF ABDOMINAL DIAGNOSTIC X-RAY EXAMINATIONS BY TYPE OF EXAMINATION, AGE AND SEX SOUTHERN REGION, PUERTO RICO = 1968 vee or i | ot § sca | EXAMINATION, sex] o-te | 15-29 | 30-46 45+] sora, iutat wef ase f eam | oom | a) sam | ssdonen vase 2s {isis | 5,405 22] 2,690 ‘| Peieccoeay fsef ae | ome | nis || ae sms | 129 202 2,076 404] 3,399 } tater spine | for | 3.287 | aires || eycur : yo | 1454 | 2,070 r{ sooo fo [Gastrointestinal } 62 | 1,407 1,670 79] 3,200 sete 2008 orl nes | 2205 | 20] ares | %*| citar wf 63] 206 | 208 | 2] 58 Laos . | a | ae || 0 vr] me | iam | 7] aa | 5,038 65 | 1yu20 | a675 | 20} 3,180 Peivie se] 257 | 901 | nf 240 >.0¥s sa] saa | ay205 | a7 | anos tip Joine st] we] sa | ot] ao aan we] a | ss | 20| ose Petvinter ee ee a oo] a7 | ayes | a7] tons s,s clef cr | som | ses | out] sem | eas Total nar] 1e.s00 | 27,055 | aso | 48,586 | Oe ---Page Break--- ---Page Break--- TABLE 4 6.8.0, (CRITICALLY SIGNIFICANT DOSES IN MILLIRADS BY TYPE OF EXAMINATION SOUTHERN REGION, PUERTO RICO = 1968 Genetically Significant Dose type of radon per future offspring Based on the data collected a io 07 Lumbar spine ; ba wy | { [esemoeaina teres 2 na | | sarium Foon i a an fer i rs |retvis | one oa ue | | | [ip soise | 08 Le \ | | | 2a { | | | ovrorat | Ee na ws | Suorotat mithe ms | am 2 TReractcal and Audontnal | 22.515 wom | ma . Examinations | ---Page Break--- TABLE 5 (6.8.D.) (COMPARISON OF REPORTED ANNUAL GENETICALLY SIGNIFICANT DOSE FROM DIAGNOSTIC RADIOLOGY (SELECTED COUNTRIES) rr arreany — — Significant Examinations

Bose. In Per 100 study sillsrede Population United States (1954) 4 55 3 Sweden (1955) * 2 Japan (2960) + a Southern Region of Puerto Rico (1968) | 36.2 soa aged on Population Dose From X-rays, U.S. 1964, U.S. Dept. of Health, Ed. and Welfare, 2 ---Page Break--- APPENDIX | WESTERN REGION 1968 A) DOSE MEASUREMENT -1968 B) THE GENETICALLY SIGNIFICANT DOSE 1968 ‘The following appendix contains statistical and dosimetric material referring to 1968, tabulated and updated with the male line different geographic Certain tables containing recent data on thoracic examinations GSD values, etc. were added. Computations of ---Page Break--- LIST OF TABLES ‘Table W: Number of abdominal X-ray examinations by type of examination, age and sex. Western Region, Puerto Rico-1968, ‘Table 2W: Number of thoracic X-ray examinations by type of examination and sex. Western Region, Puerto Rico-1968, ‘Table 3 W: Mean gonadal per examination dose due to each thoracic X-ray examination: Western Region, Puerto Rico-1968. ‘Table 4 W: Mean gonadal dose per X-ray examination by type of examination and by sex. Western Region, Puerto Rico-1968, ‘Table 5 W: Computation of the mean per capita gonadal dose due to a selected group of genetically hazardous abdominal diagnostic X-ray examinations Western Region, Puerto Rico-1968, ‘Table 6W: Per capita, per annum mean gonadal dose due to genetically hazardous abdominal and thoracic X-ray examinations. Western Region, Puerto Rico-1968 ‘Table 7 W: Genetically significant doses in Western Region, Puerto Rico-1968, by type of examination, ---Page Break--- vevsfeebdleond vost | esse rfclsichewtecs] orf anon] vers] wins sea] seoyf once 167] ova] sos | eses| 9924] ceor|zexepest | peor jf 4+—+—_| rt sorbet tet te 826i-oowoussne Notes NaaLssM X25 ONY BoY'NOLEReNO 0 S4AL AB NOUNS API TUMHOOEY 0 BNW wi eH ---Page Break--- ssetee |] oot we | wor | emer] otore | acre | eretee| caster | onotse | muon - = |= feet | coe | eee | czotar] aeste | users | ose corse |] oe te | os | vote | once | carte | ccorer | caate | sete | year

se ve fey | owe | estes oorte] eect | taetet avert ve {oe | omer] wets | sary | aro Re eee a ee) ae tere tt Were Oneind Today weaLSae a om ens ae 40 UA nt mew ---Page Break--- jrsterr |] vote | sores fone vseote | torre | rawr | stator | estos ---Page Break--- TABLE 4-41 MEAN GONADAL DOSE PER X-RAY EXAMINATION AY TYPE OF EXAMINATION AND BY SEX. WESTERN REGION, PUERTO RICO-1968 Millirads per examination Type of Examination Yale Female. Chest 1.81 92 Photoflvorogeaphy 2 ld ‘Tomography - - Abdonen 88, 226 Cholecystograph 9 168 Lumbar spine 69 1,336 Gastrointestinal Seris 146 632 Baris Enema 1,232 2,972 Lup. 386 21 Pelvis 904 49, Hip Joine 102 251 Pelvinetry = Lona ---Page Break--- THRE ‘COMPUTATION OF THE MEAN PER CAPITA GONADAL DOSE DUE TO A SELECTED ¢x0 ‘OF GENETICALLY HAZARDOUS ABDOMINAL DIAGNOSTIC. XRAY EXAMINA ESTER REGION, PUERTO RICO-1968 Ta Exposure | Abaorption reaciation | fer tose Dorota | Exanination | Fer otal Eatrined ype of MOTT | EMiinaeion | Honber of | Pacienee Plmsigacion [sex |tomnegens | Millicade” | taaminationd_Miiteade | rvaonen | | 98 o rr | 66ete | e{ ue | aes tsa | ayaa 206 Crotecyato-| | 10 ° aysz | 28,368 | meanby rj ws 168 ayn | 69,008 uma fe] 79 ° ssn | 376,288 rine e.| 1.450 ae 2,075 | 9,301,550 aseroineest| | 157 us ayers | 564,992 e| oar on sar__| 269,012 tari | m.| 1,200 ian aon | 2,982,272 | 1,033 197 ua _| .u9,279 tv x.) «0 36 ars | 1,083,383 | z| 999 a 3,0 | 9,196,220 vais fe on soe air | 1,907,072 n| so 2,008 | 125,302 wip voine | m6 02 rao | 919,620 | an a os 210,398 rervioeery | | 1,309 1916 aso | 3,550,014 real se] aro gaa mast | arse 5] 600.08 cos | 20,013 26,343,009 aus rorAL 461.70 wu.) | 38,364 [23st a7 ---Page Break--- soos 0g Jo} 46 sod wosiad J spe 99, “ores so} aC Sod wowed ad spats $92 "fea 20} 10S tod Uosid sd pasts SE op votetpea eset ido zadond ot ui v9 ae OC SOPH oqo on Be ve corer sey 1ree swior wST Zee Te vis STE ST EAEr) oer wea'soe vie FEET Tew sovun 3500, sovun TworNos NV3A | 896I-0D18 oLwand | SUNS TV OL WONNY 836 NoIe34 NBILE3M | 3500 NOLLWOML vu ae

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include the joint of the femur, which was found to be badly damaged. This necessitated a second operation which resulted in enormous suffering to the patient and was a probable cause of the development of bilateral pneumonia. We cite this example, from among many others, to illustrate the responsibility of the technician and the necessity of proper training. The best X-ray equipment is of no use if it's used by operators who are uninformed as to the potential hazards of X-ray techniques necessary for the reduction of unnecessary exposure. A nurse or a medical assistant—not licensed as an X-ray technician—cannot be expected to attain competency after brief instruction given by a doctor or a salesman. X-ray technology is a complex field, which requires specific training and experience, especially in the more advanced techniques. To our knowledge, only a few states require the licensing of every X-ray technician for the sake of public safety. The role of X-rays in diagnostics and in therapy is of extreme medical significance. However, since extreme health hazards may be the result of incorrect application, the operation of medical X-ray units in public and private institutions should be restricted by law to technicians educated and licensed under the close supervision of the Department of Health. The Health Department of the Commonwealth of Puerto Rico is presently trying to improve the economic and professional level of island technicians, to establish uniform Commonwealth standards and regulations to protect patients and occupationally exposed personnel. Following this brief history of the development of The X-ray Technicians Association in Puerto Rico, based upon information given by the Association President, Mrs. Ana C. Lopez de Cr, a small group of technicians organized for the first time in 1948. The Association was registered at the office of the Executive Secretary of Puerto Rico, Department of State, Apr 27, 1948. The group immediately became the standard-bearer of a profession that claimed to be legally

recognized and regulated under the laws of Puerto Rico. The preparatory school on the island at that time offered a substandard course. Only those interested in the field as a profession entered the Bayamón District Hospital and San Juan City Hospital as students. After completing their island studies, many continued to study and practice in the United States, increasing their professional knowledge. In subsequent years, the Association strived to interest the Puerto Rican Legislature in approving a law which recognized and regulated the profession. In 1968, the Legislature approved a Bill, which became Law 7. Two X-ray technicians were added to the Board of Examiners as the result of an amendment to Law 78 approved by the Legislature in 1967. Members of the Board of Examiners are: 1. Dr. José T. Medina, President 2. De Dons Tome 4. Dr. Done Correa 5. Row: Pe ie rs, Xn Tchad Pent ove nein 6. Het Pin, Physi #, Sona Sve Radome Several courses are conducted on the island to prepare X-ray technicians for licensing. The Association now hopes to raise professional standards to the university level, since a more sophisticated curriculum is required by complex modern X-ray units. The following list shows the X-ray technicians licensed since the Board of Examiners began in 1964. An estimated 800 are working in Puerto Rico. There are approximately 400-500 technicians working with X-ray units in private offices with only a practical background. 104 ---Page Break--- LICENSED X-RAY TECHNICIANS IN PUERTO RICO Name License Date License No Abreu Dovsl, Herberto 75/64 1 Acevedo Nieves, Carmen Socorro 2 Acevedo Rodriguez, Saris C. 3 Acosta, Carmen Della 4 Alea Frasquers, Rafael 5 Allende, Og 6 Alicea Catañens, Juan Bautista 7 ImodSeur Rondo, Miguel 8 Alvarez Cabrera, Lidia 9 Andale de Claudio, Rosario 10 Andino de Aivare, Sar un Arrovo Sire, damita Atocho Valentin, Rubén 12 Antoyo Velazquez, Etain 13 Aula Jastniano, Maria Luisa 14 Huerta, Carmen 15 Benitez Figueroa, Carmen 16 Berefos Paro, Srafing

18 Berrios Rivers, Deli. 19 Borrero Martinez, sis Alfredo. 20 Calderon Calderon, Hila D., a CCaraallo Soto. Liss Marfa Cordova, Carlos (Carmo Evia, Maré Luisa aria Infante, Ral ‘Castro Encarnacion, Marcelo Castro, Mari Magdalena ‘Castro Gonziler, Carmen Lydia (Castro de Thomas, Alejandra (Castro de Varela, Mara Ramonita CCentono, Ross Mi ‘Chines Rivera, Jess ‘Gintron, Alma Margie Collazo Gonzalez, Pablo T Collazo de Rivera, Ma Colin Gémer, Ana Maria CColén Rodrigues, Manuel Cordero Rodriguez, Carlos Juan Cortes Encarnacion, Juana Cortés, Carmen Iraida (Conta Gomez, Rona Milagros Crespo Romero, Idegarda 108, BSLSSSARSERSSSBESRSESS ---Page Break--- ‘Cruz Carmona, Ana Luisa Cruz de Esquerdo, Blena (Cruz Garcia, Ana Bisa (Gaus Torees Eménida (Cruz River, Fermin De Arce Oni, Florencio Disila Gales, Ramon M. De dest Gonaer, Secundine De desis Lapes, Herminia De deat Osorio, Isabel De ls Cruz Fonrodona, Juan Delgado Crespo. William Det Valle de Martinez, Carmen Dessus Medina, Vitor Diaz Abraham, Manuela ‘Disa Gabriel, Yanina Dias Medina, Evangelina Dian de Palacios. Ana Trinidad Domenech Mestre, Adels| Fehevari, Teresa Echevarrs de Torres, Dominga Falcon Rivers, Susana Feliciano, Rosa Ins Felix Ronse, Angel Lae Fernindes Rivers, Angel S Figueroa Bruno, sta Figueroa Reyes, Resalina Bruno Loseda, Josefina Castillo Ramos, Nivin Figueroa Reyes, Sonia Figueros Rodrigues, Marta Figueroo Romin, Lydia Flores ane, Juanita, Flores Santon, Catlor Ernesto Font Liacer, José Fuentes, Le M, ia Rivera, Sonia rio, Cuillermina Gauittens, Ruby €. Gonzater, Alm Ins Gonailes de Bes, Ana 106 ---Page Break--- Name ue Date License No Gonailes Lopes. rms 1129/68 86 Gonailer Hemindes, Rogerio * a Gonziler Pérer, Mariano, 8 Gotay Romero, Ceo 9 Heeninder, \deaids 0 eeninder, Maria del Paar or Heendnder Montalvo, Gabriel 82 Heendnder, Peis * 93 Inzarry de Vélez, Agipina : 9% Jsino de Arroyo, Petra A. " 96 Labrador. Angela, Helen " 96 Laboy Paggie, Noe! ” % eb, Las 98 {ein Orozco, Pablo Juan * 99 Lopes de Herndes, Antonis. 100 apes Acosta, Maria

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Site Lydia “108, pes Vellon, Delia “108 Iiuciano, Jon Anel 107 LLupuier Sentlago, Fernando Lute 108 Maldonado Blonde, Judith 109 Maldonado Ferree, Domingo 10 Maldonado de Hernindet, Celia ~ mt Marin Cuevas sara Lu: uz Martero Ortiz iba ek a ns Mavtero Rodrigues, Dolores * ne Martines, Ans Ine. ns Martinez Forts, Mara V. * ne Martines, Leis Lat - nt Master de Morales, Eulalia “ns Martinez Ojeda, Rafael “19 Martins Ori. César B, “120 Matos Nieves, Ramén 121 Matos Ori, ima. 123 Maysonet de Butist, Hilda. 123 Medina Rivers. Migueling 124 oj de Dia, fae Maria. 135 Moléndea. Stara. 126 Molindes Sanchez, Elba. at Moreado de Cordevo, Mat 128 107 ---Page Break--- Mercado, Maria Herminia Merced de Flores, Bath Mili, Luz Maria Miranda, Areos G. Miranda Mos, Josefina ‘Moreno Garni, Eusebio Monserrate Micanda, Maria M. Montero Cruz, Masia Dolores Morales Andino, Héctor Morales de Cardona, Leticia ‘Mores de Dine, Marta ‘Morales de Machargo, Enriqueta ‘Morales, Emma Encarnacion ‘Moree Ori, Jone 8 Morales de Ramos, Maria M. Morales Rosa, Aida Esther ‘Muior de Coldn, Monserate Mutioz Orza, Felipe Nite, Esther Maria [Navarro Archilla, Roberto Negron, dosé i. Nieto de Alvarez, Marie A Nieves, Ricardo, [Nieves Biez, Marfa Socoro [Nieves de Pintado, Ana Irene Nieves Santiago, Awilda Nites Rivera, Nelly casio Bermides, Avrora casio Vazquez, Pedro Juan Olivero, Praca B, Ortoga de Reyer, Carmen E, Ortn de Car Ortiz Espinosa, duanita Ortie de Paleon, Marta ‘José Ernesto Lis Felipe Oris Quiles, Resaldo Pabey Rodrigue, Antonia Pada Gonadles, Miriam Pagan Vale, Asuncién de Vive, Fea niagua Rondon, Guadalupe Parla de Denies, Emina Parrila de Verdejo, Feicta 108 License No, a9 131 133 ---Page Break--- Péter Serrano, Wiliam Phipps, Esther Noor Pintado, Emilio Pintado Reyes. Graciiano Pinto de Velgoques, Julia E. Planae Sosa, Raquel ‘Quintans Ramos, Preto de Divila Edel ‘Quintero de Delgado, Carmen, Raldin, Juan A, Ramery Bard, Lats B

Ramirez Aimoddvar, Fernando Ly Ramirez, Maris Teresa Ramee de Rivors, Miguelina Ramos Ayala, Dunn 'Ramos Cabin, Milagros 'Ramos Calderon, Rose 'Ramos, Carmen Laida Amor Colan, Eva Ramos Figueroa, Erasmo Reyes, Carmen (Rijs de Melecio), Carmen Luz Reyes Reyes, Lis Donato Rivera Boog, Hermes Olive 'Rivers Carto, Nile Rivera Colbn, Angel Luis Rivera Guadalupe, Mael Rivers, Sabe Rivera Matis, Isabel Rivera Lopes, Maria G. Rivera Martine, Héctor Las Rivera Meténdea, Ol Rivers Carmona, Modesta Rivera, Pedro L Rivera de Rosario, Carmen Le Rivera Sanjrjo, Gloria Dolores Rivera Suire, Milagros Robles Rosado, Hibernia Tanue Date 8/15/64 109 ---Page Break--- Rodríguez Carmons, Carlos M, 8/6/64 Rodríguez Cintrín, Adriana - Rodríguez, Bdna Raquel Rodríguez de Encarnación, Normal Rodrigues, Luz Leida Rodríguez Hernández, Ido Zoraida Rodríguez Jiménez, Griselda Rodríguez de Rivers, Laura Rodríguez, Matilde Rodríguez Rodríguez, Margarita Rodríguez de Toledo, Edith Rodríguez de Torres, Francisca Rodríguez Torte, Lidia B. Rotrinaez Varga, Maria Rodriguez, Victor M Roman Archeval, Els Román de Rodríguez, Minerva Romero Rosado, Haque! Ross, David Rosato de Borges, Bulaha Roaaio Iatesias, Zoi Rosario Mortnes, Harry Rousrio Santon, Label Rosano Vier, Victoria Rowilo Febus, Ramona Rowo Ferrivoi, Calon Rote Cacti, Aa Le Sanchez Gonzales, José A. 'Inches Rosario, José Lats Santiago Cra, Lyn Esther Santiago Pormta, Luis Santiago Rivers, Jose Ania Santiago Rodriguez, Concepción Santiago Rodriguez, Tris M. 'Santiago Rodriguez, Sara Santiago Rolon, Aurelio Santor Rivera, Carmen Asmidia Serrano Siet, Juanita Siaca Nevares, Juanita Sera, Jacinto Álvarez Laneza Salgado, Carmen 7/22/64 ate, Feticiano, Milton A. no License No. a7 a za 243 28 243 246 248 249 250 251 252 253 254 288 286 287 ---Page Break--- Name Issue Date License No, 'Aler Rie, Sila 33/68 259 Silva de Cortes, Luz Maria * 260 Soria Salaberry, Oseat * 261 Sostee Oyoln, Josefina * 262 Soto Diaz, Ana María * 263 Soto Montes, Elisa * 268 Soto Gladys, Eneida * 265 Soto Velizquez, Olga * 266

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Miguel 28 ‘Torres Montalvo, Juan Francisco 26 ‘Torres, Maria Mercodes 76 ‘Torres Navi, Elisa a ‘Torres Rosado, Francisco 28 Torres Soto, Jorge 29 ‘Torres Villafae, Juan Amador 280 Valentin, Nectar V. 281 Valdés Fersindes, Josefa 282 Vargas Corin, Juan 283 Vizquer diméne, Carmen 284 Vazquee Rodriguez, Carmen 285 aquee Expinoss, Gloria M 286 Virquee Ramos, Félix 287 Valentin Miranda, Ramon I 281 alent, Nécta V. 282 Valdés Fernder, Josete 283 Vargas Cortés, dan 288 Viaques diméner, Carmen I 285 Viaquez Rodrigues, Carmen 236 Viizquez Espinosa, Gloria 287 Viagjuer Ramos, Fax 288 Veechin, Alicia 289 Velazquer Crispin, Maria Socotra 290 Vega Copis, Wiliam 291 Volizquez Rojas, Dolores 292 Velazquez Zayas, Mercedes 299 ‘Vélez Pagin, Paulina 204 ‘Vigo Vigo, Antonia 295 a ---Page Break--- Name Issue Date License No, Zeno Figueroa, Reinaldo 296 Barhoss Acevedo, Sonserrate 297 Andino Davila dost 81964 298 Colorado Gonziles dia 299 Fruliner Adolfo, Edson 300 Figueroa Romero, Carmen Maria " sot Gonzdies, Iu 302 Gurmin Rosell Laie 03 Inzarey Herndndes, Carmen 308 ‘Landin de Romén, Eda Carmen 305 apes Sincher, Ana Hilda 206 307 : os 309 310 au Rodrigues Torees, Clara az ‘Torres Collazo, Palit 313 Amaro Martinez, Rubén A. 9/2/68 aus (Cruz, Luz Blenie ais Monge Gomez, Ana Laz a6 Sinches Lebron, Esteban air Brito Caballero, Heda a8 ‘Ayala dioénez, Ana Maria ais (Cruz Rivera, Vitoria 320 tence, Rose A, r0/21/64 sat Benitez, Miguel C. 322 Beriter de Puig, Angela 323 Colin de Pagin, Adelsida aoe Medina Rivers, Mata Lis 325 Maldonado, Luis Antonio 226 (Otmo de Falero, Candido 327 Osorio Diaz, Marts 328 Ont, Glons Mar 329 Quitones de Oramas, Lilian 30 Rivera Reyes, Julio César aa Rodriguez Cedeés, Milton A. 332 Sila Frenindes, Carmen A. 333 Viera

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