Statistics of Ionizing Radiation Applications and Management

Atomic Energy Council

2022/10

PreFace

As technology rapidly advances and develops, applications of ionizing radiation have been widely adopted in medicine, agriculture, industry, border controls, and academic research. As the use of radioactive materials and equipment capable of producing ionizing radiation increases, the demand for personnel qualified to operate radiation sources and manage radiation operations has also increased.

In order to provide a complete overview of ionizing radiation applications in various fields, the Atomic Energy Council (AEC) has compiled the latest data, tables, and figures for review by radiation personnel and related stakeholders.

1. Radiation source licenses:

   Radiation source licenses are divided into "medical use" and "non-medical use" depending on the specific use. In 2021, there were 21,835 medical use licenses and 14,056 non-medical use licenses, with a total of 35,891 licenses in Taiwan.

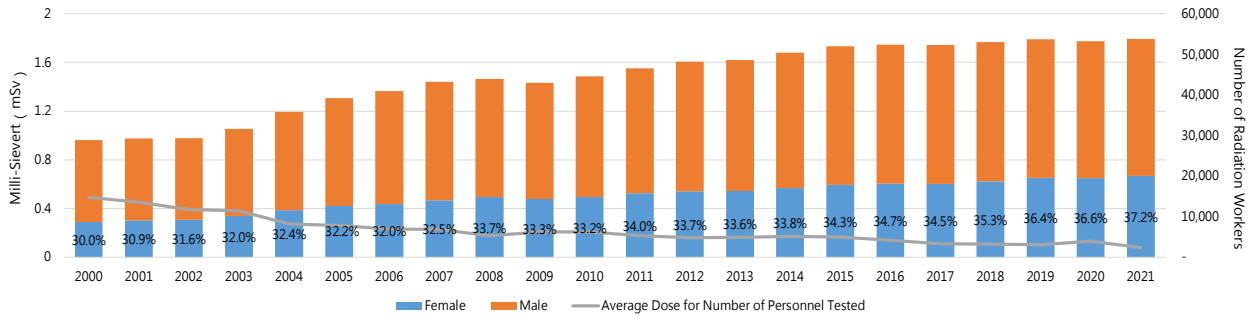
Radiation Sources / Type	Equipment	Materials	Total
Medical Use	21,328	507	21,835
Non-Medical Use	10,361	3,695	14,056
Total	31,689	4,202	35,891
Unit：Number of Licenses			

2. Personnel dose:

   In order to ensure the radiation safety of radiation workers, the AEC requires that the occupational exposure of radiation workers shall not exceed the dose limit in

accordance with Article 15 of the "Ionizing Radiation Protection Act". Therefore, employers should implement personal radiation monitoring. Moreover, according to the "Safety Standards for Protection against Ionizing Radiation" revised and implemented in 2003, the dose limits of occupational exposure for radiation workers is "the effective dose shall not exceed 100 mSv over a cycle of five consecutive years, and not exceed 50 mSv in any single year".

There were 53,804 radiation workers in Taiwan in 2021. The male to female ratio was 62.8%: 37.2%. Since 2011, the proportion of female employees has remained steady at more than 1/3 and has stably increased year by year. The annual average occupational dose was 0.08 mSv in 2021. For further details, please refer to the "Occupational Radiation Exposure Statistics Annual Report 2021". (https://www.aec.gov.tw/u/v/58)



3. Personnel certificates:

Personnel certificates issued by the AEC are divided into two categories: (1) "Radiation Safety Certificate" for personnel who are only qualified to operate radiation sources; and (2) "Radiation Protection Personnel Certificate" for those

qualified to operate radiation sources and are also responsible for radiation operation management.

(1) Radiation Safety Certificate：

Since 2003, the AEC has issued a total of 13,616 Radiation Safety Certificates, with the male to female ratio of 84.4%:15.6%. The validity period of the license is 6 years. In the past 6 years (from 2016 to 2021), a total of 4,317 certificates had been issued, and the male to female ratio was 78.1%: 21.9%.

(2) Radiation Protection Personnel Certificate：

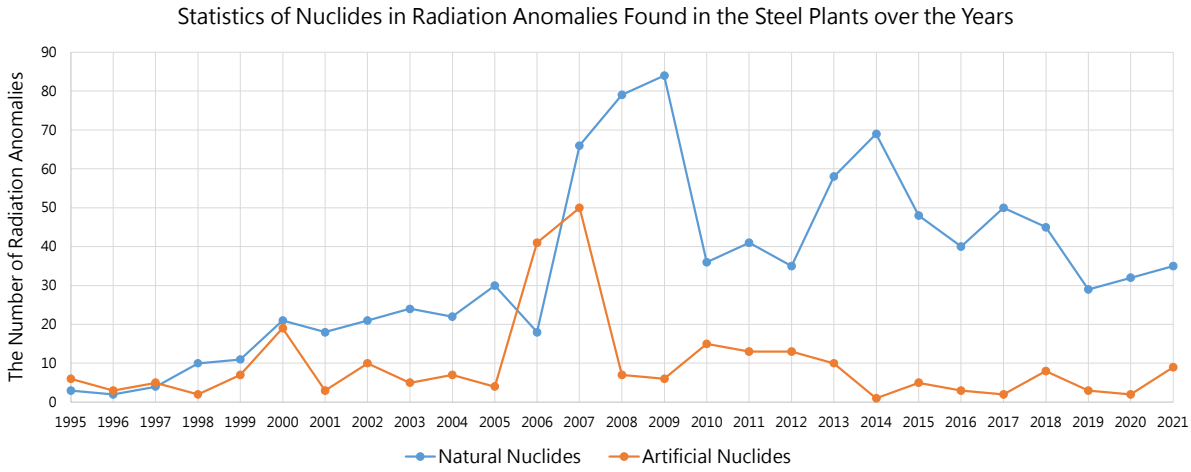
Since 2003, the AEC has issued a total of 3,924 Radiation Protection Personnel Certificates, with the male to female ratio of 65.2%:34.8%. In the past 6 years (from 2016 to 2021), a total of 2,297 certificates had been issued, and the male to female ratio was 63.4%: 36.6%.

Number of Issued Certificates in recent 6 years(2016-2021)						
	Radiation Safety Certificate			Radiation Protection Personnel Certificate		
Age Interval	Female	Male	Gender Ratio (Female : male, Unit: %)	Female	Male	Gender Ratio (Female : male, Unit: %)
	(Unit：people)			(Unit：people)		
80~88	0	5	0：100	0	4	0：100
70~79	0	17	0：100	0	18	0：100
60~69	48	347	12.2：87.8	27	246	9.9：90.1
50~59	175	871	16.7：83.3	141	420	25.1：74.9
40~49	289	1,077	21.2：78.8	306	362	45.8：54.2
30~39	294	828	26.2：73.8	291	344	45.8：54.2
18~29	138	228	37.7：62.3	75	63	54.3：45.7
Total	944	3,373	21.9：78.1	840	1,457	36.6：63.4

The above table shows the gender ratio is getting closer among people aged between 18 and 49 who possess Radiation Protection Personnel Certificates. This sign indicates an increasing trend of women holding important positions in the workplace. Through strengthening radiation protection knowledge and safety awareness of control measures, gender inequality in the workplace is declining.

4. The number of radiation anomalies found in the steel plants:

A total of 44 cases were found in 2021. Anomalies caused by natural radionuclides account for 79.5% (35 out of 44) of radiation anomalies found in steel plants.



The above statistics were compiled as at the end of 2021 and will be updated annually. Please feel free to contact us if there is any mistake.

Content

1. Radiation Sources Licenses (Medical Use)

(1) Number of Licenses for All Types of Medical Institution Installed with Medical Radiation Sources by county/city

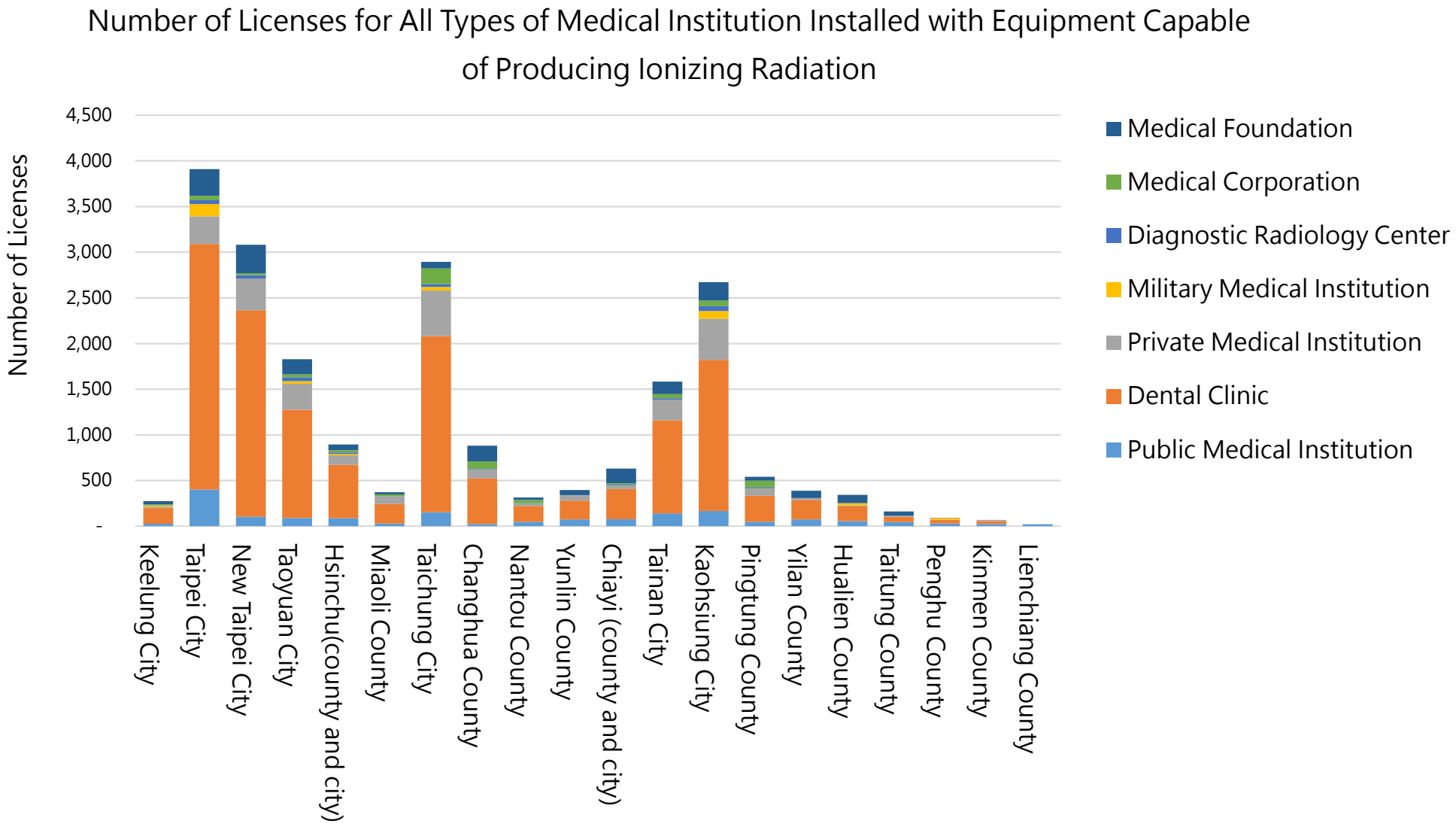
Institution / County/City	Permit						Registration					
	Public Medical Institutions			Private Medical Institutions			Public Medical Institutions			Private Medical Institutions		
	Equip-ment	Seal-ed	Un-sealed	Equip-ment	Seal-ed	Un-sealed	Equip-ment	Seal-ed	Un-sealed	Equip-ment	Seal-ed	Un-sealed
Keelung City	0	0	0	2	0	2	40	0	0	233	2	0
Taipei City	20	8	11	15	6	10	512	80	0	3,360	43	2
New Taipei City	0	0	2	19	7	9	103	1	0	2,958	33	0
Taoyuan City	2	1	2	13	3	7	118	4	0	1,694	30	0
Hsinchu(county and city)	2	2	2	3	1	2	102	4	0	786	10	0
Miaoli County	0	0	0	2	0	1	28	0	0	341	2	0
Taichung City	7	4	4	20	8	10	185	6	0	2,682	31	0
Changhua County	1	0	0	6	3	3	23	0	0	850	8	0
Nantou County	1	0	1	1	0	0	46	0	0	266	0	0
Yunlin County	2	1	2	2	0	1	72	6	0	318	0	0
Chiayi (county and city)	1	1	1	8	3	4	75	0	0	547	16	0
Tainan City	3	2	1	11	2	4	137	8	0	1,433	11	0
Kaohsiung City	7	2	4	21	6	7	242	3	0	2,402	25	0
Pingtung County	1	0	0	4	1	2	51	0	0	483	1	0
Yilan County	1	0	1	3	0	2	72	1	0	310	5	0
Hualien County	0	0	0	3	3	3	82	0	0	257	12	0
Taitung County	0	0	0	2	0	1	44	0	0	115	0	0
Penghu County	0	0	0	0	0	0	46	0	0	45	0	0
Kinmen County	0	0	0	0	0	0	22	0	0	45	0	0
Lienchiang County	0	0	0	0	0	0	20	0	0	0	0	0
Total	48	21	31	135	43	68	2,020	113	0	19,125	229	2

Remarks:

1. Equipment: Equipment capable of producing ionizing radiation.
2. Sealed: Sealed radioactive material.
3. Unsealed: Unsealed radioactive material.

(2) Number of Licenses for All Types of Medical Institution Installed with Equipment Capable of Producing Ionizing Radiation by county/city

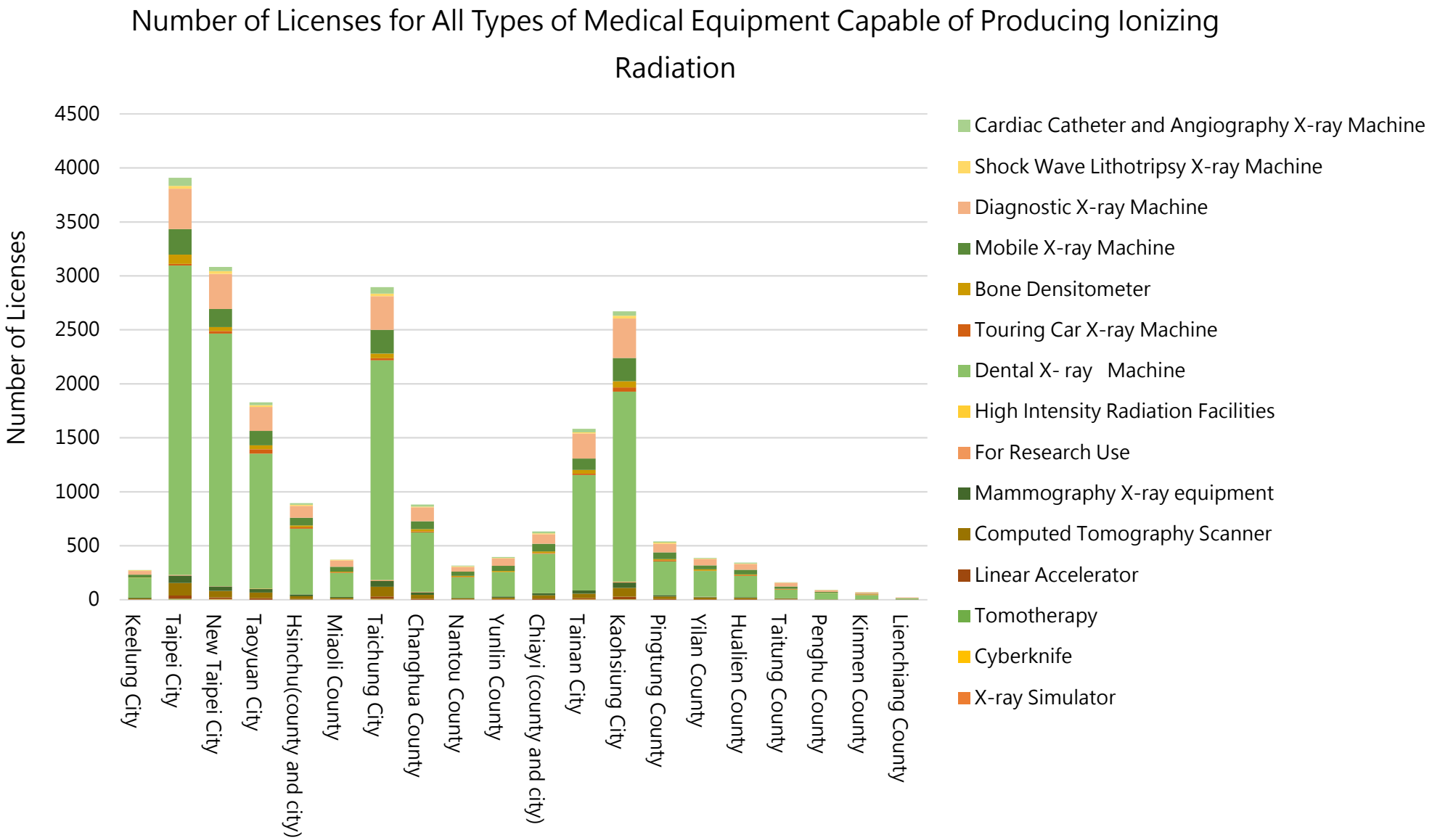
Institution / County/City	Public Medical Institution	Dental Clinic	Private Medical Institution	Military Medical Institution	Diagnostic Radiology Center	Medical Corporation	Medical Foundation	Total
Keelung City	26	171	17	14	1	7	39	275
Taipei City	401	2,687	305	133	43	47	293	3,909
New Taipei City	103	2,259	350	0	37	19	313	3,081
Taoyuan City	90	1,184	284	30	42	32	165	1,827
Hsinchu(county and city)	87	584	104	17	15	24	62	893
Miaoli County	28	213	87	0	0	20	23	371
Taichung City	152	1,930	497	40	32	170	73	2,894
Changhua County	24	498	99	0	6	81	172	880
Nantou County	47	174	25	0	4	37	27	314
Yunlin County	74	204	59	0	3	0	54	394
Chiayi (county and city)	76	329	40	0	7	16	163	631
Tainan City	140	1,017	228	0	16	44	137	1,582
Kaohsiung City	166	1,653	452	83	54	60	203	2,671
Pingtung County	47	284	75	5	15	71	42	539
Yilan County	73	215	20	0	1	0	77	386
Hualien County	56	159	12	26	1	0	88	342
Taitung County	44	59	8	0	2	0	48	161
Penghu County	29	40	3	17	0	0	2	91
Kinmen County	22	33	12	0	0	0	0	67
Lienchiang County	20	0	0	0	0	0	0	20
Total	1,705	13,693	2,677	365	279	628	1,981	21,328


Number of Licenses for All Types of Medical Institution Installed with Equipment Capable of Producing Ionizing Radiation
Number of Licenses
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
-
Keelung City
Taipei City
New Taipei City
Taoyuan City
Hsinchu(county and city)
Miaoli County
Taichung City
Changhua County
Nantou County
Yunlin County
Chiayi (county and city)
Tainan City
Kaohsiung City
Pingtung County
Yilan County
Hualien County
Taitung County
Penghu County
Kinmen County
Lienchiang County
Medical Foundation
Medical Corporation
Diagnostic Radiology Center
Military Medical Institution
Private Medical Institution
Dental Clinic
Public Medical Institution

(3) Number of Licenses for All Types of Medical Equipment Capable of Producing Ionizing Radiation by county/city

Equipment / County/City	X-ray Simulator	Cyberknife	Tomotherapy	Linear Accelerator	Computed Tomography Scanner	Mammography X-ray Equipment	For Research Use	High Intensity Radiation Facilities	Dental X-ray Machine	Touring Car X-ray Machine	Bone Densitometer	Mobile X-ray Machine	Diagnostic X-ray Machine	Shock Wave Lithotripsy X-ray Machine	Cardiac Catheter and Angiography X-ray Machine	Total
Keelung City	0	0	0	2	10	6	1	0	184	0	3	26	33	6	4	275
Taipei City	0	1	7	29	117	68	6	0	2,866	15	87	237	374	26	76	3,909
New Taipei City	1	1	4	15	60	41	1	0	2,342	23	37	168	324	26	38	3,081
Taoyuan City	0	0	0	14	52	32	3	1	1,251	39	38	132	223	17	25	1,827
Hsinchu (county and city)	0	0	1	4	27	16	0	0	610	13	17	71	108	11	15	893
Miaoli County	0	0	0	2	14	8	0	0	224	4	7	45	59	5	3	371
Taichung City	2	1	4	22	90	55	8	0	2,036	18	43	219	313	23	60	2,894
Changhua County	0	0	0	7	37	24	4	0	551	8	22	73	128	8	18	880
Nantou County	0	0	0	2	9	6	0	0	190	5	8	38	44	6	6	314
Yunlin County	1	0	0	4	14	9	0	0	227	0	10	47	70	5	7	394
Chiayi (county and city)	0	0	0	9	30	19	1	0	366	7	15	71	87	8	18	631
Tainan City	1	1	2	9	42	30	0	0	1,070	12	34	105	234	11	31	1,582
Kaohsiung City	0	1	2	23	82	50	7	1	1,761	38	58	215	366	27	40	2,671

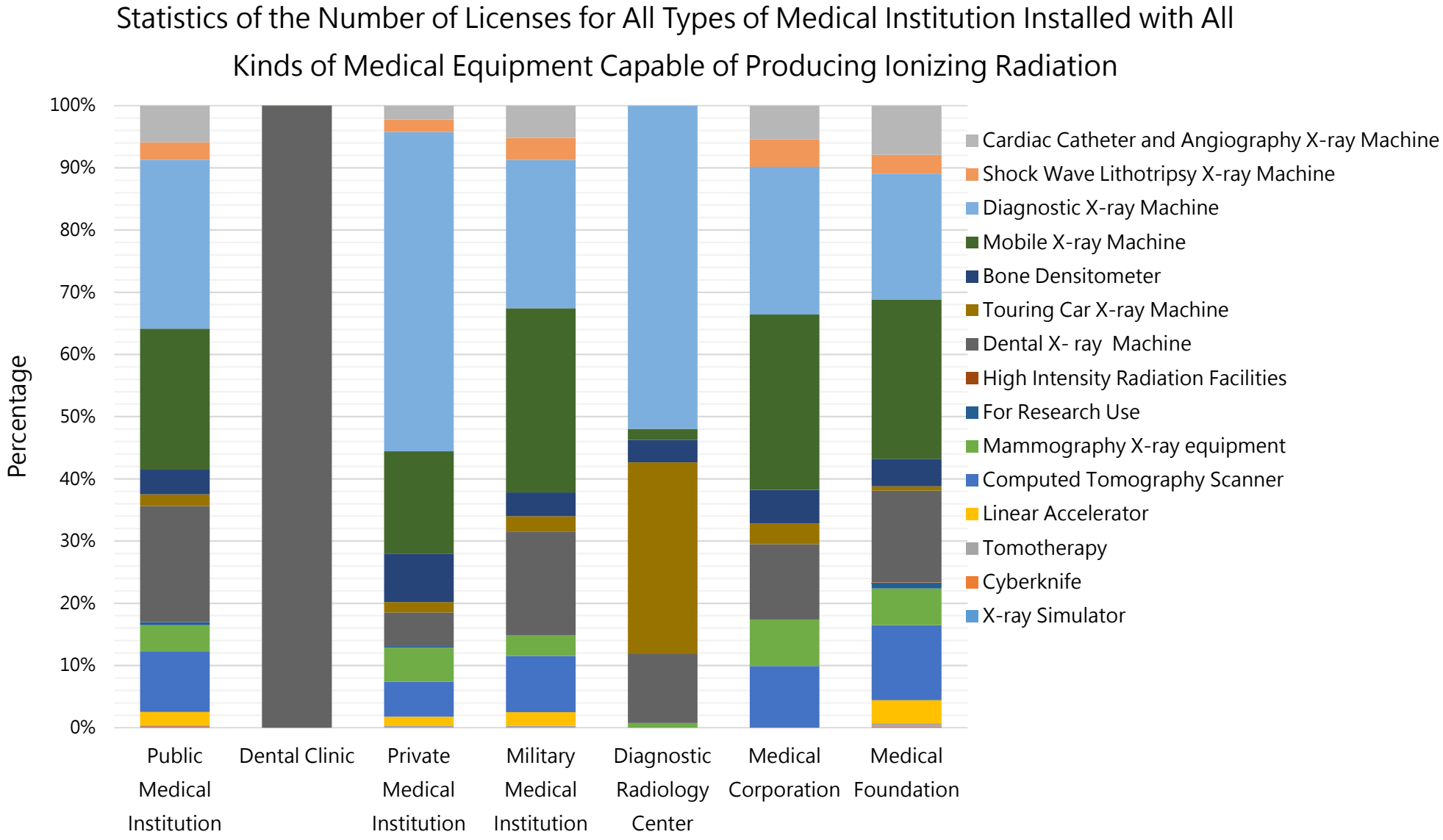
Pingtung County	0	0	0	5	24	13	0	0	311	11	12	62	80	10	11	539
Yilan County	0	0	0	4	16	5	1	0	240	1	13	38	58	4	6	386
Hualien County	0	0	0	3	13	7	0	0	197	6	8	43	53	5	7	342
Taitung County	0	0	0	2	8	4	0	0	78	4	4	22	33	3	3	161
Penghu County	0	0	0	0	2	1	0	0	58	0	2	9	16	1	2	91
Kinmen County	0	0	0	0	2	1	0	0	39	3	5	5	10	1	1	67
Lienchiang County	0	0	0	0	2	1	0	0	9	0	0	2	6	0	0	20
Total	5	5	20	156	651	396	32	2	14,610	207	423	1,628	2,619	203	371	21,328


Number of Licenses for All Types of Medical Equipment Capable of Producing Ionizing Radiation
Number of Licenses
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Keelung City
Taipei City
New Taipei City
Taoyuan City
Hsinchu(county and city)
Miaoli County
Taichung City
Changhua County
Nantou County
Yunlin County
Chiayi (county and city)
Tainan City
Kaohsiung City
Pingtung County
Yilan County
Hualien County
Taitung County
Penghu County
Kinmen County
Lienchiang County
Cardiac Catheter and Angiography X-ray Machine
Shock Wave Lithotripsy X-ray Machine
Diagnostic X-ray Machine
Mobile X-ray Machine
Bone Densitometer
Touring Car X-ray Machine
Dental X- ray Machine
High Intensity Radiation Facilities
For Research Use
Mammography X-ray equipment
Computed Tomography Scanner
Linear Accelerator
Tomotherapy
Cyberknife
X-ray Simulator

(4) Statistics of the Number of Licenses for All Types of Medical Institution Installed with All Kinds of Medical Equipment Capable of Producing Ionizing Radiation

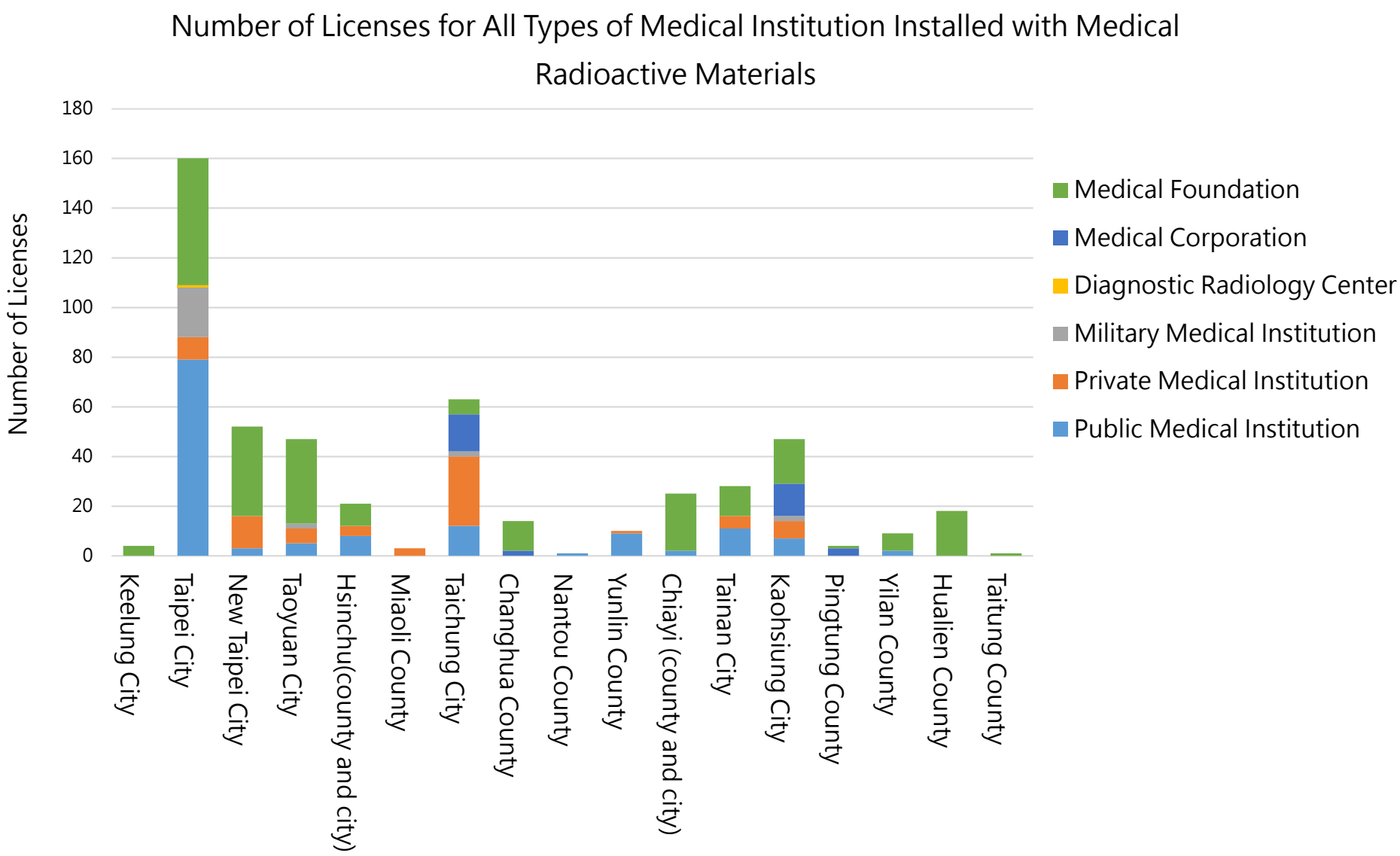
Equipment / Institution	X-ray Simulator	Cyberknif-e	Tomothera-py	Linear Accelerat-or	Computed Tomograp-hy Scanner	Mammogra-phy X-ray Equipment	For Research Use	High Intensity Radiation Facilities	Dental X- ray Machine	Touring Car X-ray Machine	Bone Densito-meter	Mobile X-ray Machine	Diagnostic X-ray Machine	Shock Wave Lithotripsy X-ray Machine	Cardiac Catheter and Angiograp-hy X-ray Machine	Total
Public Medical Institution	2	2	3	36	166	72	8	0	318	32	68	386	463	48	101	1,705
Dental Clinic	0	0	0	0	0	0	0	0	13,687	1	0	5	0	0	0	13,693
Private Medical Institution	0	0	8	39	151	146	7	0	144	45	209	440	1,374	54	60	2,677
Military Medical Institution	0	0	1	8	33	12	0	0	61	9	14	108	87	13	19	365
Diagnostic Radiology Center	0	0	0	0	0	2	0	0	31	86	10	5	145	0	0	279
Medical Corporation	0	0	0	0	62	47	0	0	76	21	34	177	149	28	34	628
Medical Foundation	3	3	8	73	239	117	17	2	293	13	88	507	401	60	157	1,981
Total	5	5	20	156	651	396	32	2	14,610	207	423	1,628	2,619	203	371	21,328

Remarks: Equipment capable of producing ionizing radiation includes fixed-type and touring-type vehicles, excluding biopsy.


Statistics of the Number of Licenses for All Types of Medical Institution Installed with All Kinds of Medical Equipment Capable of Producing Ionizing Radiation
Percentage
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Public Medical Institution
Dental Clinic
Private Medical Institution
Military Medical Institution
Diagnostic Radiology Center
Medical Corporation
Medical Foundation
Cardiac Catheter and Angiography X-ray Machine
Shock Wave Lithotripsy X-ray Machine
Diagnostic X-ray Machine
Mobile X-ray Machine
Bone Densitometer
Touring Car X-ray Machine
Dental X- ray Machine
High Intensity Radiation Facilities
For Research Use
Mammography X-ray equipment
Computed Tomography Scanner
Linear Accelerator
Tomotherapy
Cyberknife
X-ray Simulator

(5) Number of Licenses for All Types of Medical Institution Installed with Medical Radioactive Materials by county/city

Institution / County/City	Public Medical Institution	Private Medical Institution	Military Medical Institution	Diagnostic Radiology Center	Medical Corporation	Medical Foundation	Total
Keelung City	0	0	0	0	0	4	4
Taipei City	79	9	20	1	0	51	160
New Taipei City	3	13	0	0	0	36	52
Taoyuan City	5	6	2	0	0	34	47
Hsinchu (county and city)	8	4	0	0	0	9	21
Miaoli County	0	3	0	0	0	0	3
Taichung City	12	28	2	0	15	6	63
Changhua County	0	0	0	0	2	12	14
Nantou County	1	0	0	0	0	0	1
Yunlin County	9	1	0	0	0	0	10
Chiayi (county and city)	2	0	0	0	0	23	25
Tainan City	11	5	0	0	0	12	28
Kaohsiung City	7	7	2	0	13	18	47
Pingtung County	0	0	0	0	3	1	4
Yilan County	2	0	0	0	0	7	9
Hualien County	0	0	0	0	0	18	18
Taitung County	0	0	0	0	0	1	1
Total	139	76	26	1	33	232	507


Number of Licenses for All Types of Medical Institution Installed with Medical Radioactive Materials
Number of Licenses
180
160
140
120
100
80
60
40
20
0
Keelung City
Taipei City
New Taipei City
Taoyuan City
Hsinchu(county and city)
Miaoli County
Taichung City
Changhua County
Nantou County
Yunlin County
Chiayi (county and city)
Tainan City
Kaohsiung City
Pingtung County
Yilan County
Hualien County
Taitung County
Medical Foundation
Medical Corporation
Diagnostic Radiology Center
Military Medical Institution
Private Medical Institution
Public Medical Institution

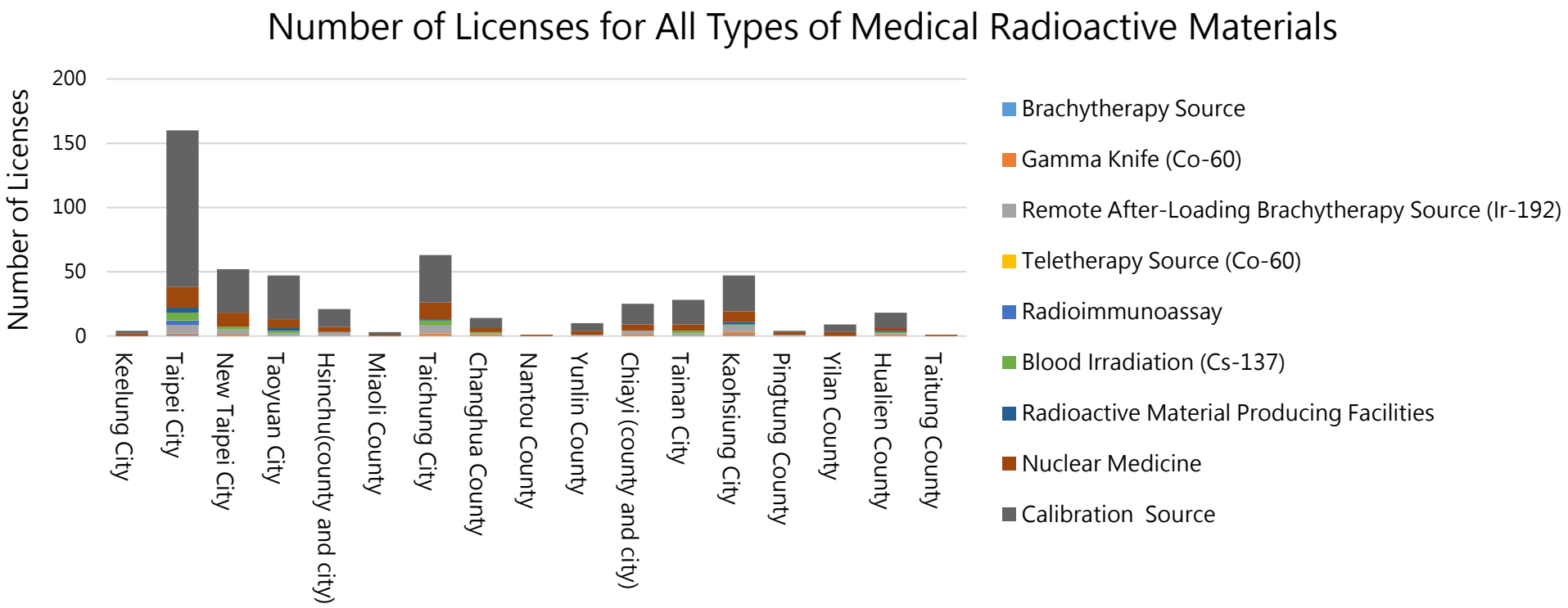
(6) Number of Licenses for All Types of Medical Radioactive Materials by county/city

Radioactive Material / County/City	Brachytherapy Source	Gamma Knife (Co-60)	Remote After-Loading Brachytherapy Source (Ir-192)	Teletherapy Source (Co-60)	Radioimmunoassay	Blood Irradiation (Cs-137)	Radioactive Material Producing Facilities[1]	Nuclear Medicine[2]	Calibration Source[3]	Total
Keelung City	0	0	0	0	0	0	0	2	2	4
Taipei City	1	1	7	0	3	6	4	16	122	160
New Taipei City	0	1	4	0	0	2	0	11	34	52
Taoyuan City	0	0	2	0	0	2	2	7	34	47
Hsinchu(county and city)	0	0	3	0	0	0	0	4	14	21
Miaoli County	0	0	0	0	0	0	0	1	2	3
Taichung City	0	2	6	0	0	4	1	13	37	63
Changhua County	0	1	1	0	0	1	0	3	8	14
Nantou County	0	0	0	0	0	0	0	1	0	1
Yunlin County	0	0	1	0	0	0	0	3	6	10
Chiayi (county and city)	0	1	3	0	0	0	0	5	16	25
Tainan City	0	0	2	0	0	2	0	5	19	28
Kaohsiung City	1	2	5	0	0	1	2	8	28	47
Pingtung County	0	0	1	0	0	0	0	2	1	4
Yilan County	0	0	0	0	0	0	0	3	6	9

Hualien County	0	1	1	0	0	1	1	2	12	18
Taitung County	0	0	0	0	0	0	0	1	0	1
Total	2	9	36	0	3	19	10	87	341	507

Remarks:

1. Radioactive material producing facilities mainly produce F-18, C-11, N-13, O-15, etc.
2. Unsealed radioactive materials used in nuclear medicine include Tc-99m, Tl-201, Ga-67, etc.
3. Sealed radioactive materials for calibration include Co-57, Ge-68, Cs-137, etc.



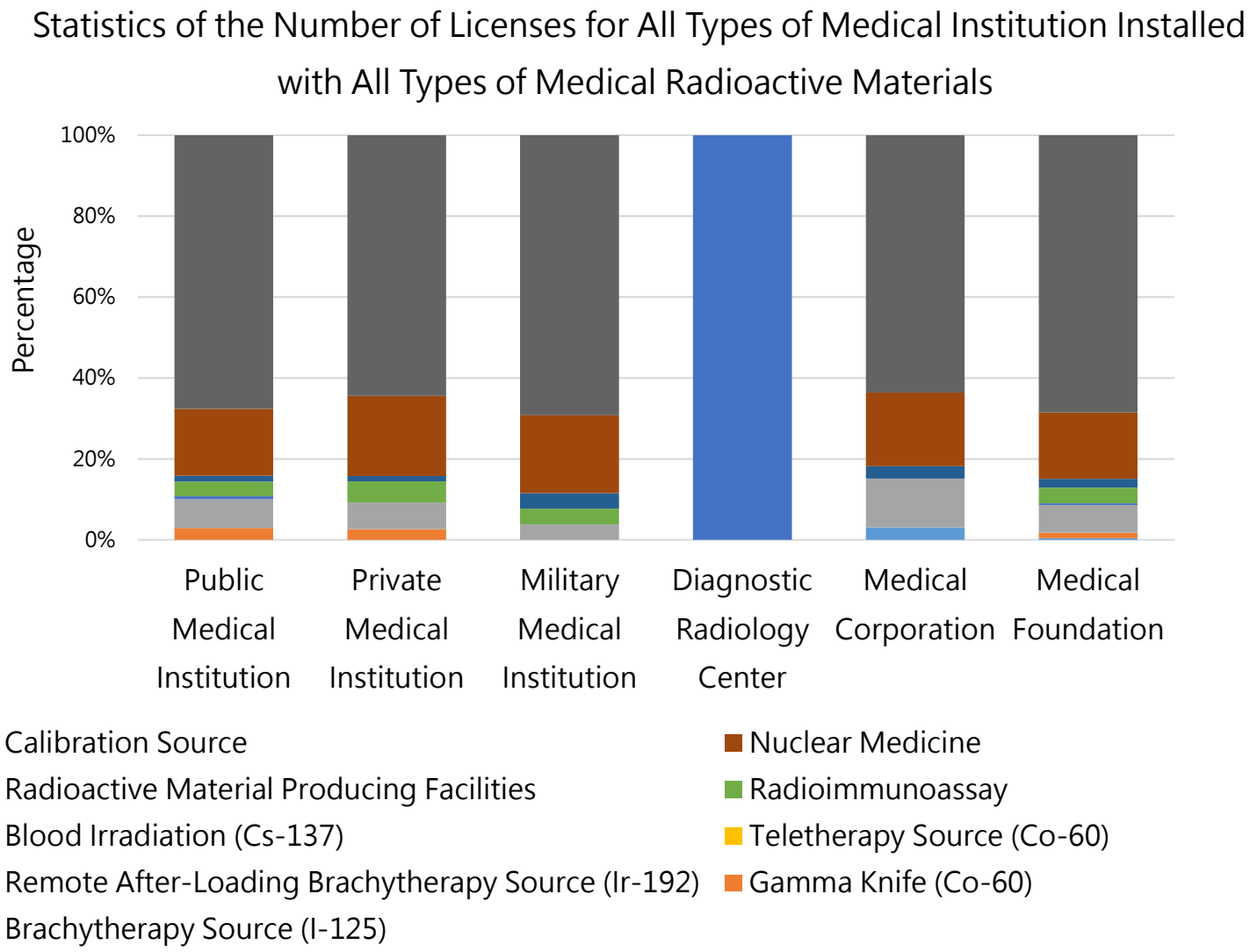
(7) Statistics of the Number of Licenses for All Types of Medical Institution Installed with All Types of Medical Radioactive Materials

Radioactive Material / Facility	Brachytherapy Source (I-125)	Gamma Knife (Co-60)	Remote After-Loading Brachytherapy Source (Ir-192)	Teletherapy Source (Co-60)	Blood Irradiation (Cs-137)	Radioimmun-oassay	Radioactive Material Producing Facilities[1]	Nuclear Medicine[2]	Calibration Source[3]	Total
Public Medical Institution	0	4	10	0	1	5	2	23	94	139
Private Medical Institution	0	2	5	0	0	4	1	15	49	76
Military Medical Institution	0	0	1	0	0	1	1	5	18	26
Diagnostic Radiology Center	0	0	0	0	1	0	0	0	0	1
Medical Corporation	1	0	4	0	0	0	1	6	21	33
Medical Foundation	1	3	16	0	1	9	5	38	159	232
Total	2	9	36	0	3	19	10	87	341	507

Remarks:

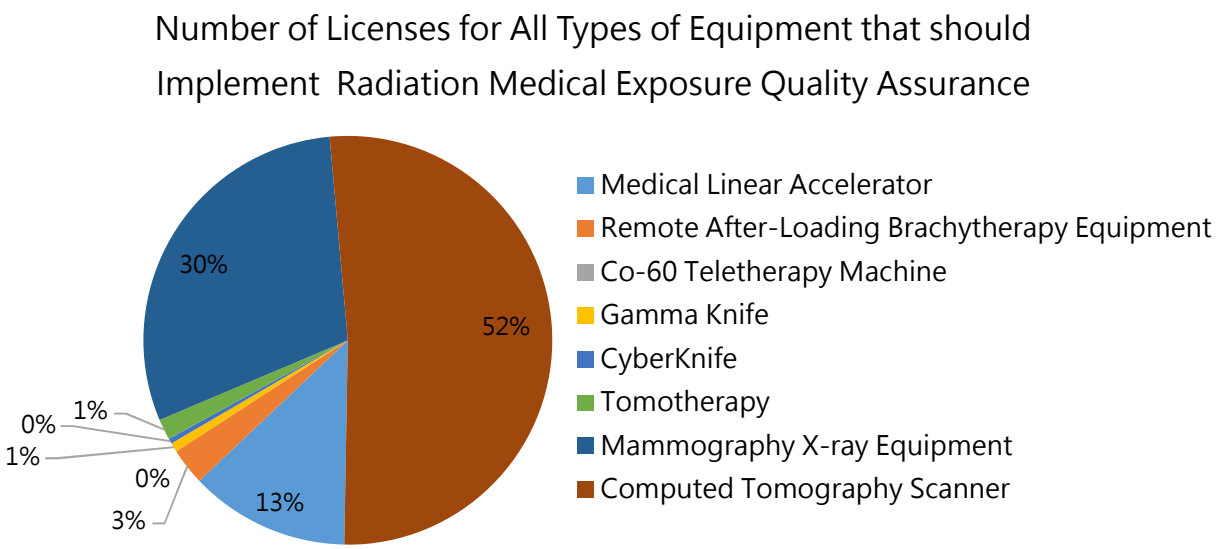
1. Radioactive material producing facilities mainly produce F-18, C-11, N-13, O-15, etc.

2. Unsealed radioactive materials used in nuclear medicine include Tc-99m, Tl-201, Ga-67, etc.
3. Sealed radioactive materials for calibration include Co-57, Ge-68, and Cs-137, etc.



(8) Number of Licenses for All Types of Equipment that should Implement Radiation Medical Exposure Quality Assurance

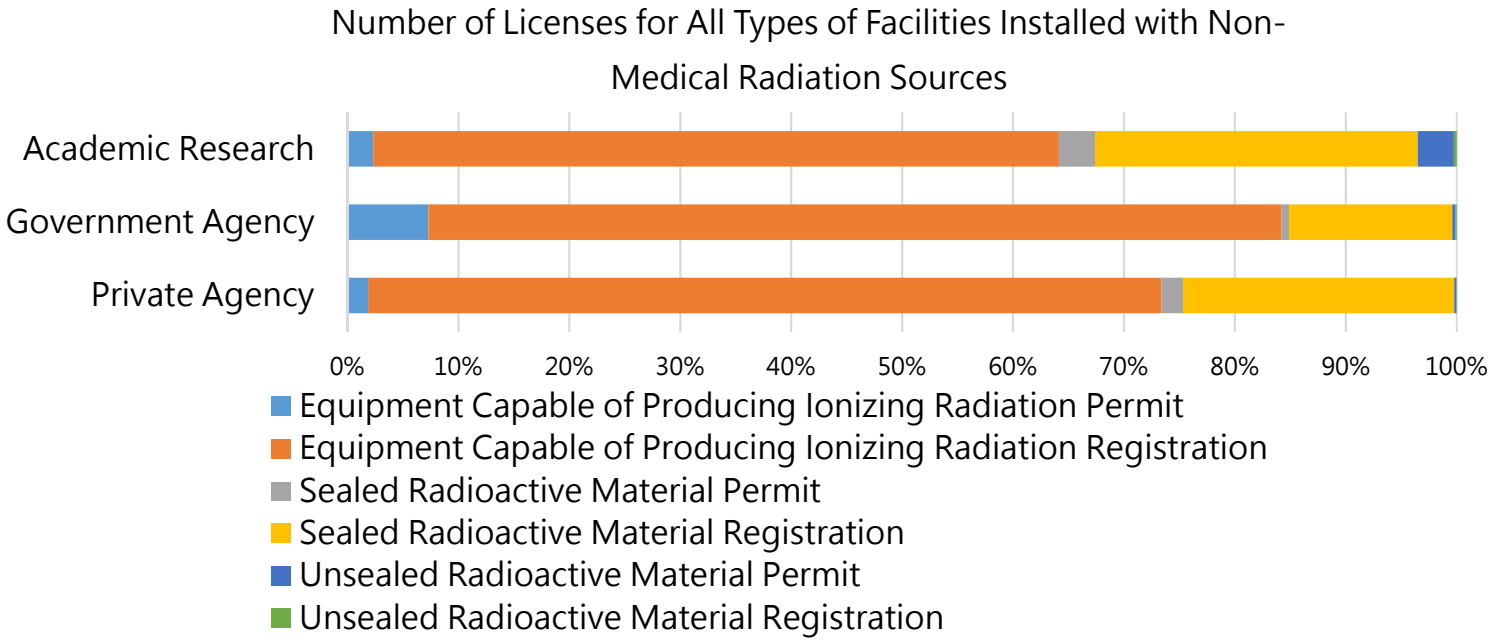
Medical Equipment	Number of Licenses
Medical Linear Accelerator	156
Remote After-Loading Brachytherapy Equipment	36
Co-60 Teletherapy Machine	0
Gamma Knife	9
CyberKnife	5
Tomotherapy	20
Mammography X-ray Equipment (not include disabled equipment)	369
Computed Tomography Scanner (not include disabled equipment)	637
Total	1,232



2. Radiation Sources Licenses (Non-Medical Use)

(1) Number of Licenses for All Types of Facilities Installed with Non-Medical Radiation Sources by type

Type / Facility	Equipment Capable of Producing Ionizing Radiation		Sealed Radioactive Material		Unsealed Radioactive Material		Total
	Permit	Registration	Permit	Registration	Permit	Registration	
Private Agency	231	8,751	235	2,993	24	2	12,236
Government Agency	77	810	7	155	3	1	1,053
Academic Research	18	474	25	223	25	2	767
Total	326	10,035	267	3,371	52	5	14,056



(2) Number of Licenses for All Types of Facilities Installed with Non-Medical Radiation Sources by county/city

Facility / County/City	Permit									Registration								
	Private Agency			Government Agency			Academic Research			Private Agency			Government Agency			Academic Research		
	Equip-ment	Sealed	Unseal-ed	Equipm-ent	Sealed	Unsea-led	Equipm-ent	Sealed	Unsea-led	Equip-ment	Sealed	Unsea-led	Equip-ment	Sealed	Unsea-led	Equip-ment	Sealed	Unsea-led
Keelung City	4	4	0	3	0	0	0	0	0	53	1	0	20	2	0	4	2	0
Taipei City	19	5	2	13	2	1	2	3	5	609	74	0	148	50	1	87	44	1
New Taipei City	12	7	9	6	4	1	0	0	0	1,292	217	0	30	35	0	8	0	0
Taoyuan City	44	16	2	19	0	0	7	16	9	1,896	513	1	311	25	0	56	54	0
Hsinchu(county and city)	8	7	2	1	0	0	6	5	3	904	391	0	8	2	0	105	35	0
Miaoli County	5	6	1	0	0	0	0	0	0	210	120	0	4	0	0	3	0	0
Taichung City	21	10	5	7	0	0	1	0	3	840	277	0	42	14	0	65	26	0
Changhua County	6	2	0	0	0	0	0	0	0	241	88	0	4	0	0	6	3	0
Nantou County	2	2	0	2	0	0	0	0	0	71	16	0	4	2	0	3	0	0
Yunlin County	6	32	0	0	0	0	2	0	0	173	203	0	4	0	0	9	3	0
Chiayi (county and city)	3	0	0	3	0	0	0	0	1	112	31	0	8	2	0	8	3	1
Tainan City	13	1	0	5	0	0	0	0	2	799	514	0	35	3	0	52	18	0
Kaohsiung City	77	138	2	8	1	1	0	1	1	1,336	390	0	100	12	0	35	17	0
Pingtung County	8	2	1	4	0	0	0	0	0	101	68	1	10	3	0	9	8	0
Yilan County	2	3	0	0	0	0	0	0	0	75	57	0	2	1	0	3	0	0
Hualien County	1	0	0	3	0	0	0	0	1	26	24	0	14	1	0	21	9	0
Taitung County	0	0	0	2	0	0	0	0	0	11	8	0	18	3	0	0	1	0
Penghu County	0	0	0	1	0	0	0	0	0	1	1	0	24	0	0	0	0	0

Kinmen County	0	0	0	0	0	0	0	0	0	1	0	0	16	0	0	0	0	0
Lienchiang County	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0
Total	231	235	24	77	7	3	18	25	25	8,751	2,993	2	810	155	1	474	223	2

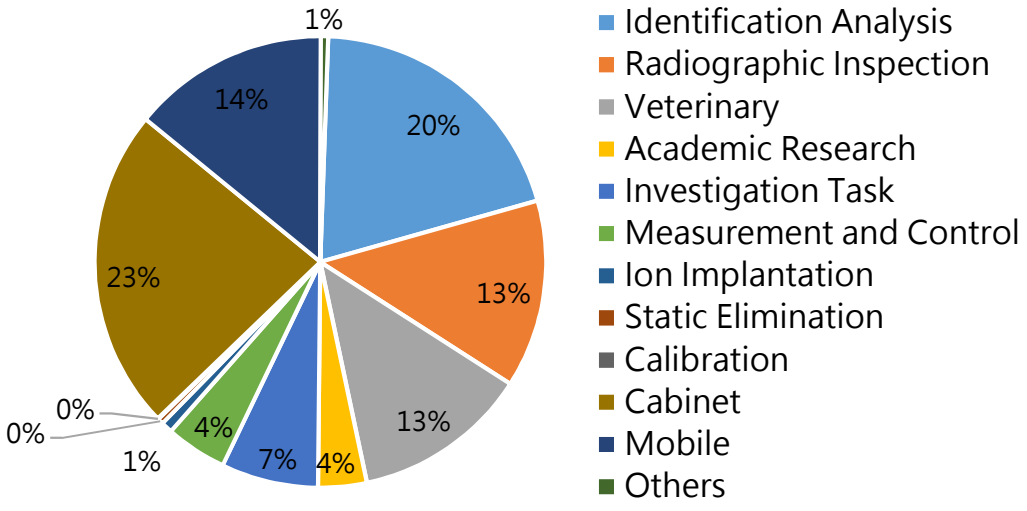
Remarks:

1. Equipment: Equipment capable of producing ionizing radiation.
2. Sealed: Sealed radioactive material.
3. Unsealed: Unsealed radioactive material.

(3) Number of Licenses for Non-Medical Equipment Capable of Producing Ionizing Radiation for Various Purposes

Equipment Usage	Number of Licenses
Identification Analysis	2,079
Radiographic Inspection	1,396
Veterinary	1,305
Academic Research	361
Investigation Task	720
Measurement and Control	455
Ion Implantation	84
Static Elimination	43
Calibration	6
Cabinet	2,395
Mobile	1,463
Others*	54
Total	10,361

* "Others" refers to the equipment held by the sales and manufacturing industry and is not classified.

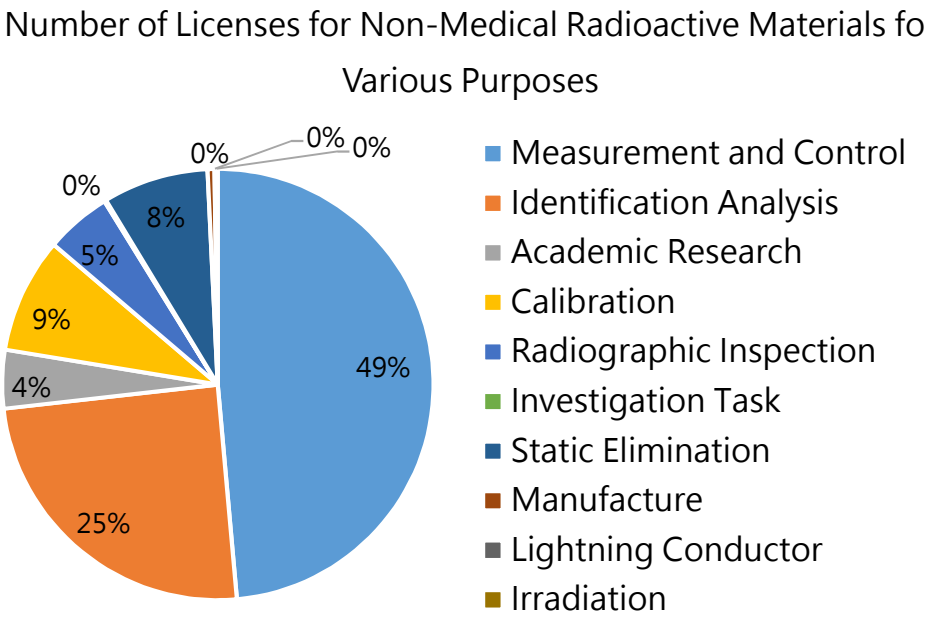


(4) Number of Licenses for Non-Medical Radioactive Materials for Various Purposes

Radioactive Material Usage	Number of Licenses
Measurement and Control	1,795
Identification Analysis	910
Academic Research	162
Calibration	319
Radiographic Inspection	183
Investigation Task	5
Static Elimination	293
Manufacture[1]	19
Lightning Conductor[2]	3
Irradiation[3]	6
Total	3,695

Remarks:

1. Manufacture usage includes packaging and manufacturing.
2. Lightning conductors use Am-241 sources.
3. Irradiation refers to the irradiation of agricultural products, medical products, etc.



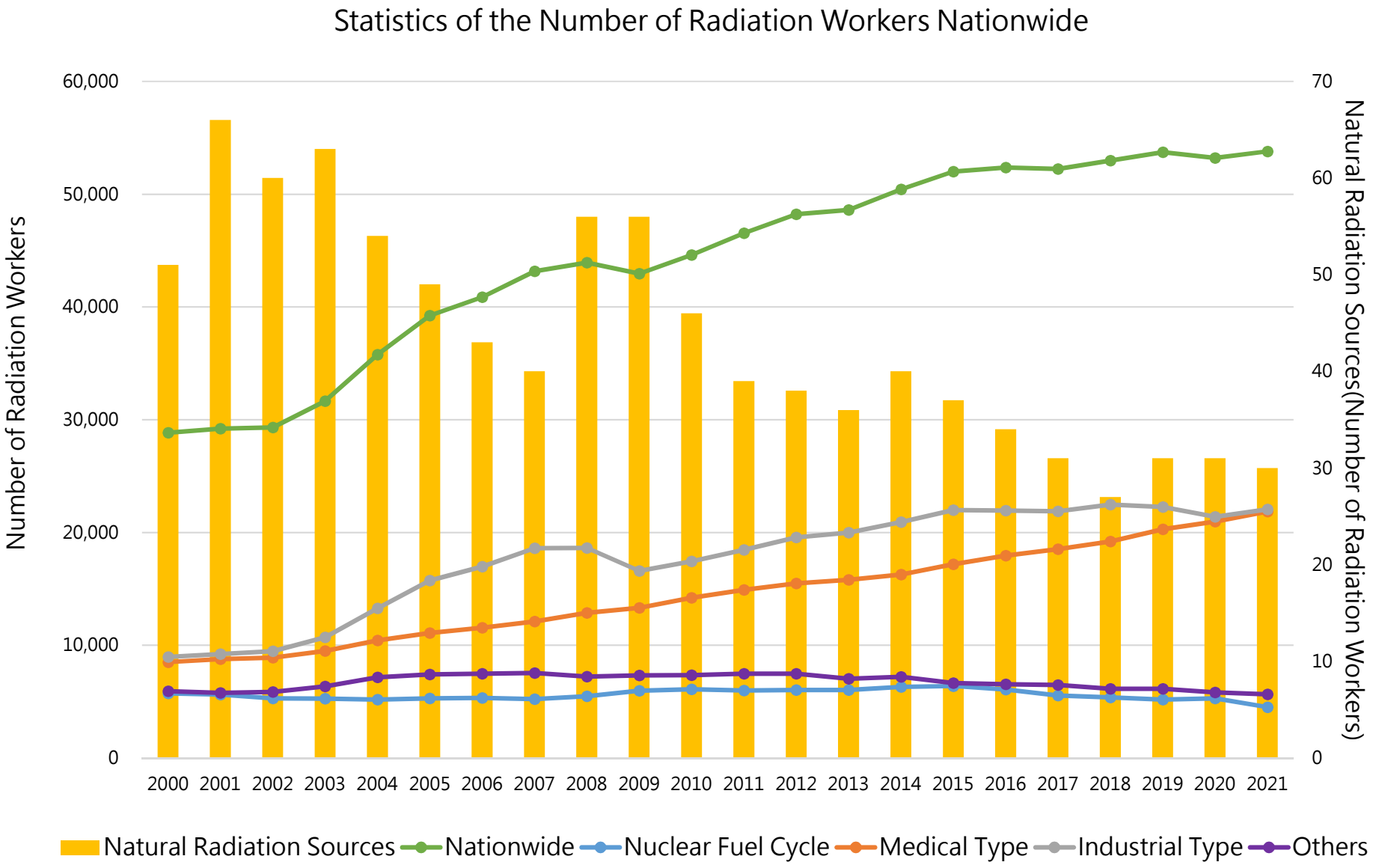
3. Personnel Dose

(1) Statistics of the Number of Radiation Workers Nationwide

Year	Nuclear Fuel Cycle	Medical Type	Industrial Type	Natural Radiation Sources[1]	Others[2]	Nationwide[3]
2000	5,731	8,510	8,960	51	5,925	28,856
2001	5,622	8,775	9,221	66	5,786	29,223
2002	5,296	8,914	9,468	60	5,857	29,325
2003	5,281	9,504	10,702	63	6,361	31,649
2004	5,189	10,425	13,272	54	7,167	35,782
2005	5,287	11,101	15,754	49	7,410	39,242
2006	5,325	11,561	16,966	43	7,472	40,881
2007	5,232	12,110	18,615	40	7,541	43,170
2008	5,473	12,873	18,639	56	7,221	43,940
2009	5,971	13,321	16,588	56	7,329	42,966
2010	6,093	14,207	17,435	46	7,360	44,607
2011	6,001	14,920	18,465	39	7,482	46,545
2012	6,026	15,482	19,576	38	7,473	48,225
2013	6,040	15,804	20,002	36	7,031	48,617
2014	6,313	16,272	20,919	40	7,199	50,437
2015	6,384	17,199	21,995	37	6,659	52,012
2016	6,084	17,958	21,951	34	6,540	52,369
2017	5,557	18,522	21,877	31	6,479	52,248
2018	5,383	19,199	22,479	27	6,137	52,995
2019	5,189	20,291	22,269	31	6,142	53,723
2020	5,286	20,970	21,406	31	5,832	53,220
2021	4,513	21,866	22,046	30	5,645	53,804

Remarks：

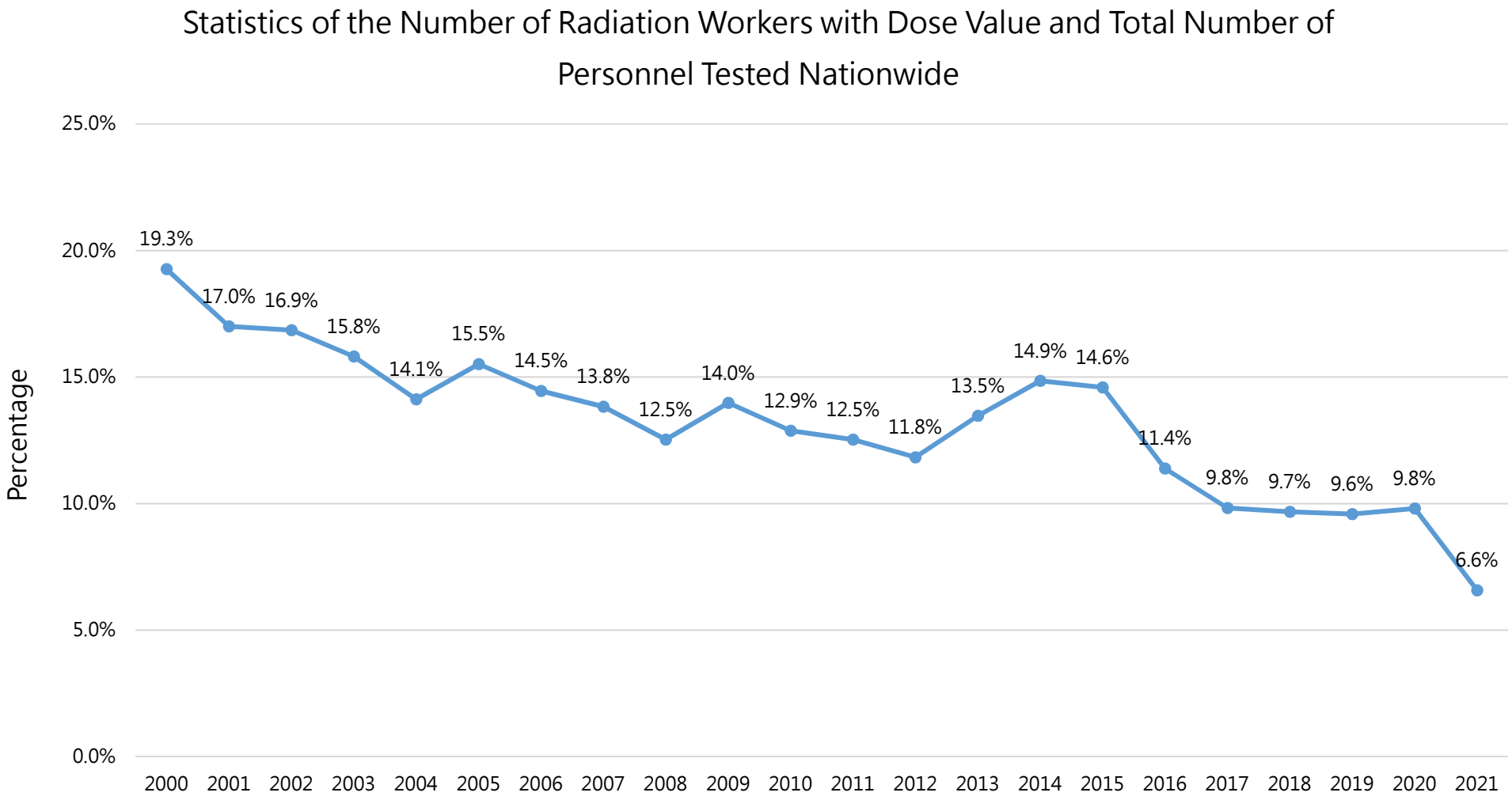
1. Natural radiation sources include civil aircraft, oil, gas, and mineral and ore processing.
2. Others category includes educational institutions, veterinarians and a few difficult to classify.
3. National dose badge usage statistics includes radiation workers and non-radiation workers as defined by law/regulations.
4. Because some workers are engaged in more than two types of radiation works, the total number of personnel tested nationwide will be less than the total number of various types of work.


Statistics of the Number of Radiation Workers Nationwide
Number of Radiation Workers
Natural Radiation Sources(Number of Radiation Workers)
60,000
50,000
40,000
30,000
20,000
10,000
0
70
60
50
40
30
20
10
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Natural Radiation Sources
Nationwide
Nuclear Fuel Cycle
Medical Type
Industrial Type
Others

(2) Statistics of the Number of Radiation Workers with Dose Value and Total Number of Personnel Tested Nationwide

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of People with Dose Value	5,559	4,970	4,943	5,006	5,052	6,088	5,908	5,969	5,504	6,008	5,745	,5831	5,704	6,551
Total Number of Personnel Tested	28,856	29,223	29,325	31,649	357,82	39,242	40,881	43,170	43,940	42,966	44,607	46,545	48,225	48,621
Percentage	19.3%	17.0%	16.9%	15.8%	14.1%	15.5%	14.5%	13.8%	12.5%	14.0%	12.9%	12.5%	11.8%	13.5%

Year	2014	2015	2016	2017	2018	2019	2020	2021
Number of People with Dose Value	7,492	7,589	5,966	5,132	5,127	5,148	5,220	3,537
Total Number of Personnel Tested	50,438	52,012	52,369	52,248	52,995	53,723	53,220	53,804
Percentage	14.9%	14.6%	11.4%	9.8%	9.7%	9.6%	9.8%	6.6%

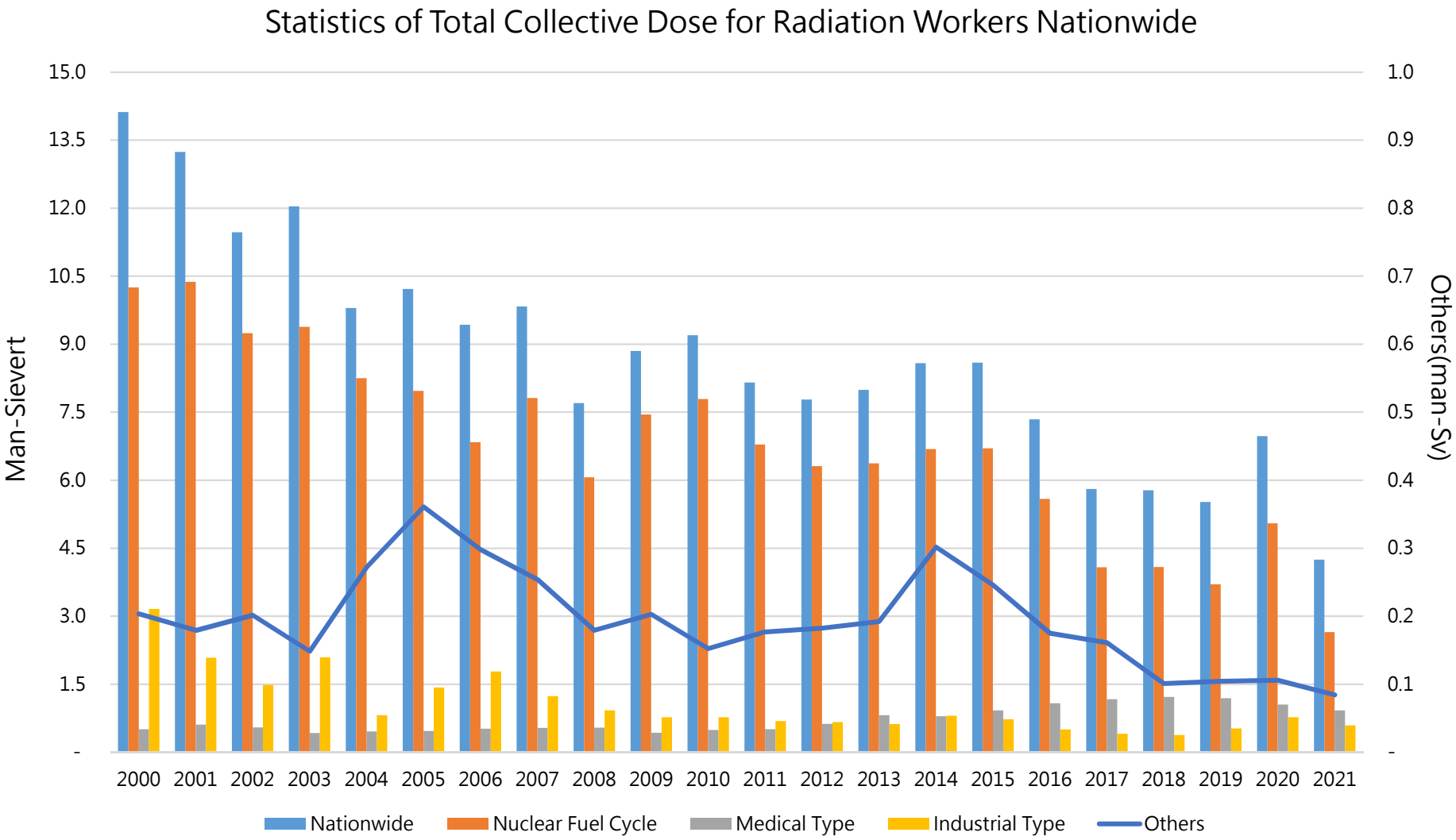

Statistics of the Number of Radiation Workers with Dose Value and Total Number of Personnel Tested Nationwide
Percentage
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
19.3%
17.0%
16.9%
15.8%
14.1%
15.5%
14.5%
13.8%
12.5%
14.0%
12.9%
12.5%
11.8%
13.5%
14.9%
14.6%
11.4%
9.8%
9.7%
9.6%
9.8%
6.6%
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

(3) Statistics of Total Collective Dose for Radiation Workers Nationwide

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Nationwide	14.12	13.24	11.47	12.04	9.79	10.22	9.43	9.83	7.70	8.85	9.19	8.15	7.78	7.99	8.58	8.59
Nuclear Fuel Cycle (Nuclear Power Plant)	10.25	10.37	9.24	9.38	8.25	7.97	6.83	7.81	6.06	7.45	7.79	6.79	6.31	6.37	6.69	6.70
Medical Type	0.50	0.61	0.55	0.42	0.45	0.46	0.52	0.53	0.54	0.43	0.49	0.50	0.62	0.81	0.79	0.92
Industrial Type (Non-Medical)	3.16	2.08	1.48	2.09	0.82	1.42	1.78	1.23	0.92	0.77	0.77	0.68	0.66	0.61	0.81	0.72
Others (Research)	0.20	0.18	0.20	0.15	0.27	0.36	0.30	0.25	0.18	0.20	0.15	0.18	0.18	0.19	0.30	0.25
Natural Radiation Sources	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Year	2016	2017	2018	2019	2020	2021
Nationwide	7.34	5.80	5.78	5.52	6.97	4.24
Nuclear Fuel Cycle (Nuclear Power Plant)	5.59	4.08	4.08	3.70	5.05	2.65
Medical Type	1.08	1.16	1.21	1.19	1.05	0.92
Industrial Type (Non-Medical)	0.51	0.40	0.38	0.52	0.77	0.59
Others (Research)	0.17	0.16	0.10	0.10	0.11	0.08
Natural Radiation Sources	0.00	0.00	0.00	0.00	0.00	0.00

Unit：Man-Sievert（man-Sv）

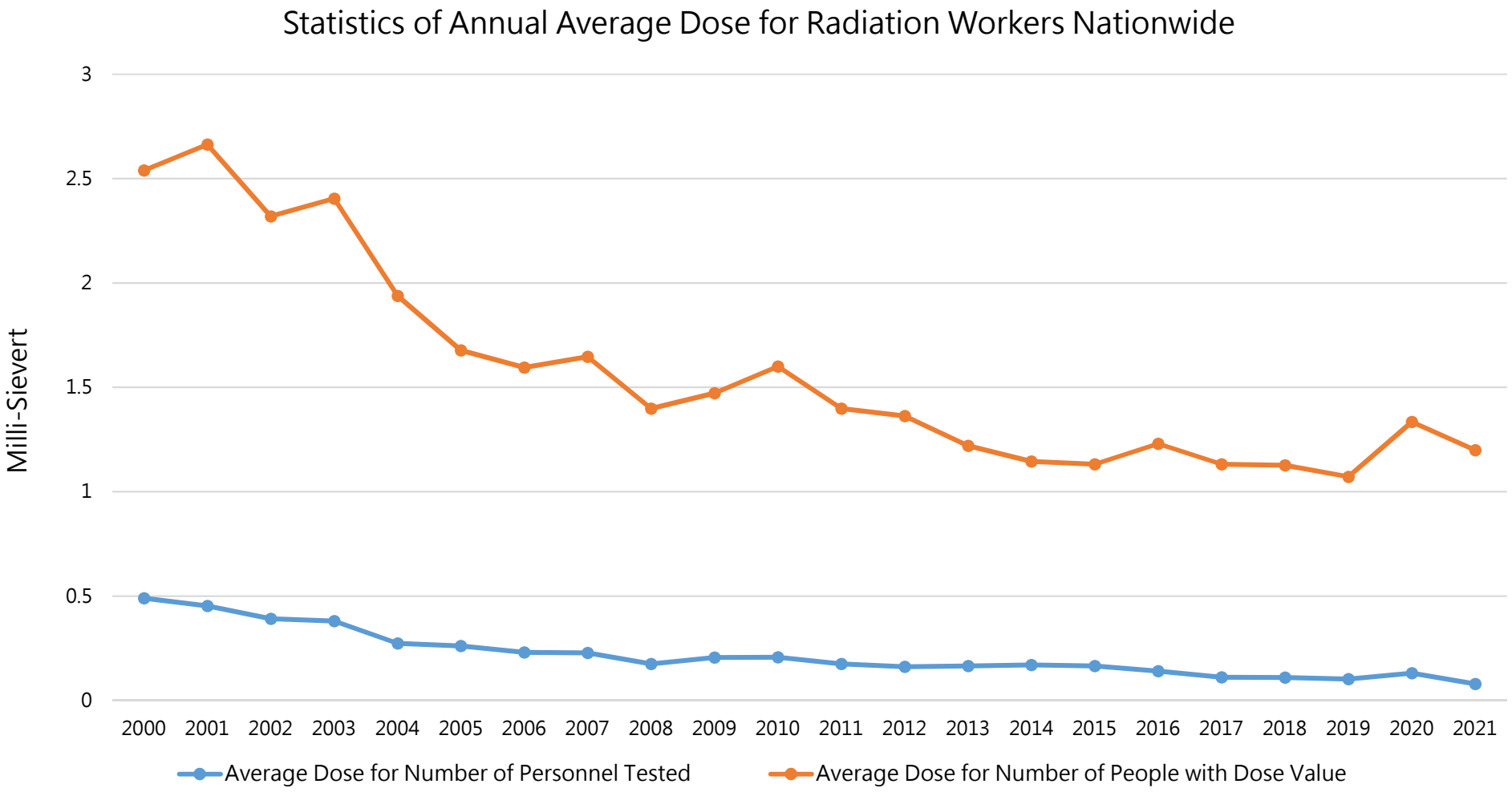

Statistics of Total Collective Dose for Radiation Workers Nationwide
Man-Sievert
Others(man-Sv)
15.0
13.5
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
-
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
-
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Nationwide
Nuclear Fuel Cycle
Medical Type
Industrial Type
Others

(4) Statistics of Annual Average Dose for Radiation Workers Nationwide

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Dose for Number of Personnel Tested	0.49	0.45	0.39	0.38	0.27	0.26	0.23	0.23	0.18	0.21	0.21	0.18	0.16	0.16	0.17	0.17
Average Dose for Number of People with Dose Value	2.54	2.66	2.32	2.40	1.94	1.68	1.60	1.65	1.40	1.47	1.60	1.40	1.36	1.22	1.15	1.13

Year	2016	2017	2018	2019	2020	2021
Average Dose for Number of Personnel Tested	0.14	0.11	0.11	0.10	0.13	0.08
Average Dose for Number of People with Dose Value	1.23	1.13	1.13	1.07	1.34	1.20

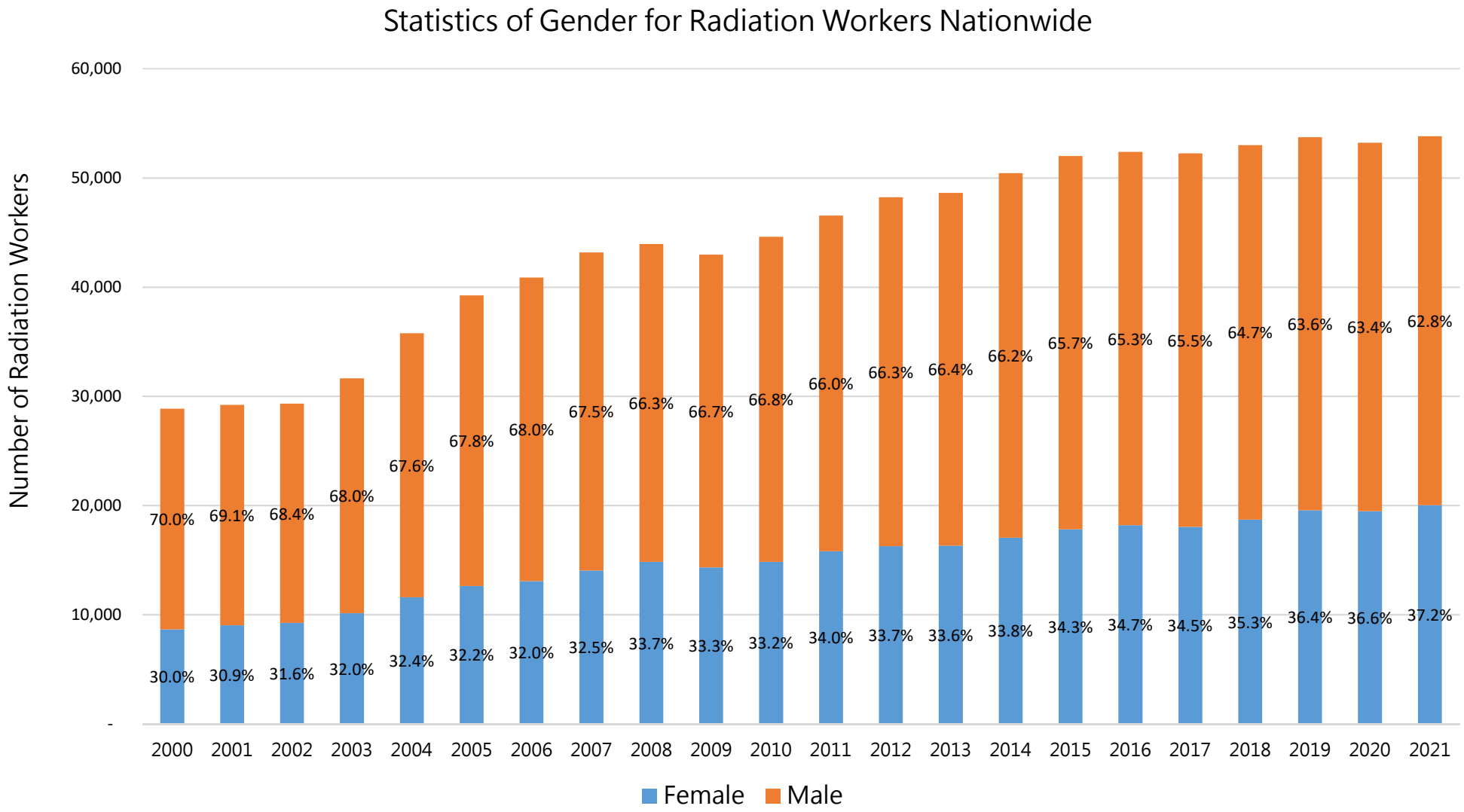
Unit：Milli-Sievert（mSv）


Statistics of Annual Average Dose for Radiation Workers Nationwide
Milli-Sievert
3
2.5
2
1.5
1
0.5
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Average Dose for Number of Personnel Tested
Average Dose for Number of People with Dose Value

(5) Statistics of Gender for Radiation Workers Nationwide

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Male	20,201	20,194	20,069	21,507	24,194	26,620	27,816	29,122	29,112	28,639	29,778	30,740	31,950	32,298
Female	8,655	9,029	9,256	10,142	11,588	12,622	13,065	14,048	14,828	14,327	14,829	15,805	16,275	16,319
Total	28,856	29,223	29,325	31,649	35,782	39,242	40,881	43,170	43,940	42,966	44,607	46,545	48,225	48,617
Male Ratio (%)	70.0%	69.1%	68.4%	68.0%	67.6%	67.8%	68.0%	67.5%	66.3%	66.7%	66.8%	66.0%	66.3%	66.4%
Female Ratio (%)	30.0%	30.9%	31.6%	32.0%	32.4%	32.2%	32.0%	32.5%	33.7%	33.3%	33.2%	34.0%	33.7%	33.6%

Year	2014	2015	2016	2017	2018	2019	2020	2021
Male	33,397	34,190	34,178	34,210	34,283	34,163	33,750	33,771
Female	17,040	17,822	18,191	18,038	18,712	19,560	19,470	20,033
Total	50,437	52,012	52,369	52,248	52,995	53,723	53,220	53,804
Male Ratio (%)	66.2%	65.7%	65.3%	65.5%	64.7%	63.6%	63.4%	62.8%
Female Ratio (%)	33.8%	34.3%	34.7%	34.5%	35.3%	36.4%	36.6%	37.2%


Statistics of Gender for Radiation Workers Nationwide
Number of Radiation Workers
60,000
50,000
40,000
30,000
20,000
10,000
-
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
70.0% 69.1% 68.4% 68.0% 67.6% 67.8% 68.0% 67.5% 66.3% 66.7% 66.8% 66.0% 66.3% 66.4% 66.2% 65.7% 65.3% 65.5% 64.7% 63.6% 63.4% 62.8%
30.0% 30.9% 31.6% 32.0% 32.4% 32.2% 32.0% 32.5% 33.7% 33.3% 33.2% 34.0% 33.7% 33.6% 33.8% 34.3% 34.7% 34.5% 35.3% 36.4% 36.6% 37.2%
Female
Male

(6) Statistics of the Number of Radiation Workers in Each Dose Interval Nationwide (Unit: person)

Dose Interval (mSv)	≦LLD	≦ 1	1-2.5	2.5-5	5-7.5	7.5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-100	> 100
2000	23,297	3,296	891	549	272	191	169	90	47	26	15	8	3	0	2	0
2001	24,253	2,774	891	539	251	161	187	86	36	24	17	0	3	0	1	0
2002	24,382	2,907	857	519	225	148	155	77	40	8	5	1	0	0	1	0
2003	26,643	3,001	801	520	228	157	135	84	43	21	7	7	2	0	0	0
2004	30,730	3,152	822	512	196	126	165	75	1	1	0	2	0	0	0	0
2005	33,154	4,018	935	528	245	143	159	52	3	1	2	1	1	0	0	0
2006	34,973	3,991	854	526	214	140	132	31	13	2	5	0	0	0	0	0
2007	37,201	3,922	909	586	221	126	156	43	3	2	1	0	0	0	0	0
2008	38,436	3,644	948	503	186	118	98	6	1	0	0	0	0	0	0	0
2009	36,958	3,968	941	593	254	145	99	8	0	0	0	0	0	0	0	0
2010	38,862	3,652	961	614	238	138	121	21	0	0	0	0	0	0	0	0
2011	40,714	3,884	977	507	238	134	81	10	0	0	0	0	0	0	0	0
2012	42,519	3,758	1,030	531	201	103	68	12	1	0	0	0	0	0	0	0
2013	42,063	4,601	1,008	556	196	93	77	19	0	1	0	0	0	0	0	0
2014	42,944	5,431	1,072	542	246	101	87	11	0	0	0	0	0	0	0	0
2015	44,413	5,413	1,188	569	220	111	81	7	0	0	0	0	0	0	0	0
2016	46,403	4,200	950	477	159	87	80	13	0	0	0	0	0	0	0	0
2017	47,116	3,716	756	394	136	75	50	5	0	0	0	0	0	0	0	0
2018	47,868	3,680	840	362	117	60	52	14	2	0	0	0	0	0	0	0
2019	48,575	3,713	823	364	139	60	41	8	0	0	0	0	0	0	0	0
2020	48,000	3,668	808	398	124	79	108	29	3	2	1	0	0	0	0	0
2021	50,267	2,369	719	290	83	40	32	4	0	0	0	0	0	0	0	0

LLD：Lower limit of detection

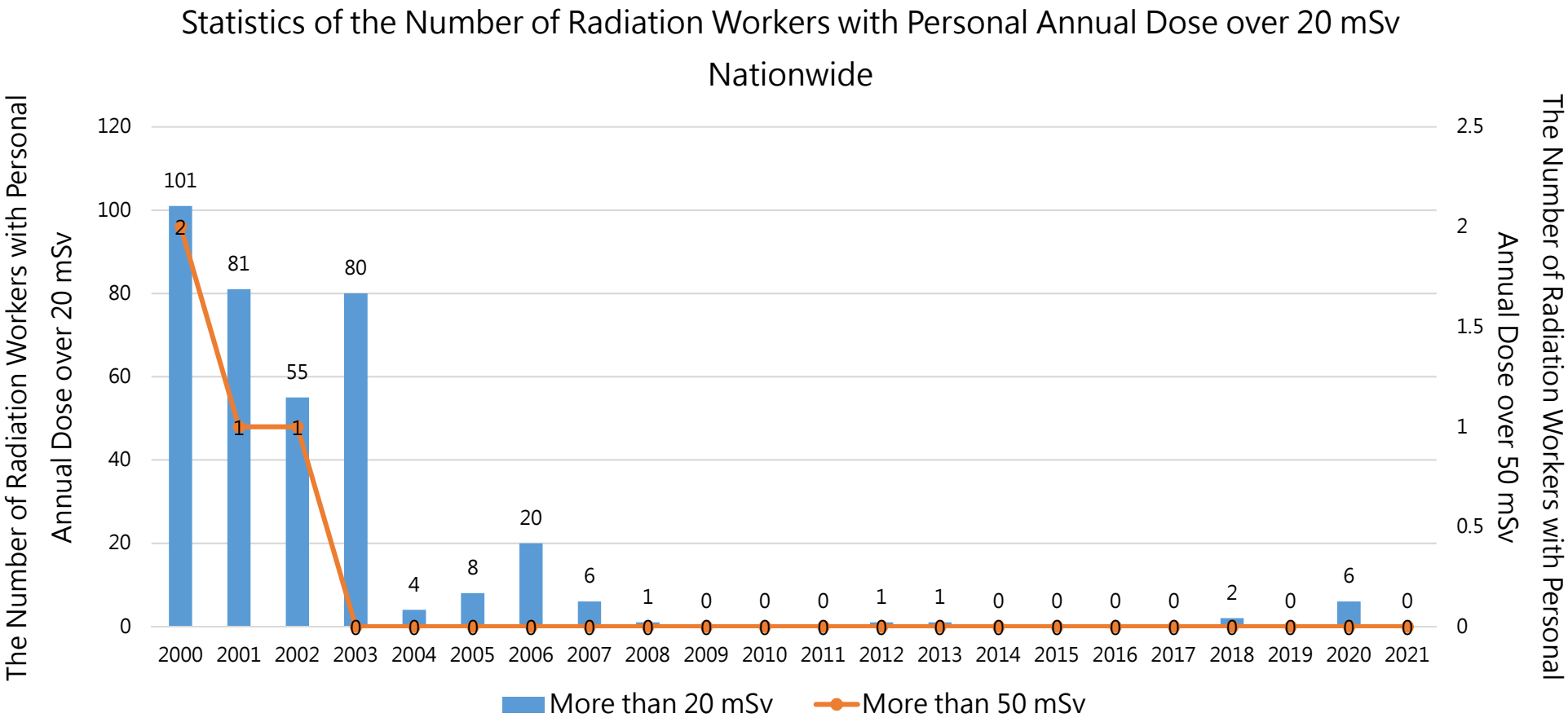
(7) Statistics of Relative Percentage of Radiation Workers in Each Dose Interval Nationwide (unit: %)

Dose Interval (mSv)	≦LLD	≦ 1	1-2.5	2.5-5	5-7.5	7.5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-100	> 100	Percentage of People with Dose Value
2000	80.7	11.4	3.1	1.9	0.9	0.7	0.6	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	19.3%
2001	83.0	9.5	3.1	1.8	0.9	0.6	0.6	0.3	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	17.0%
2002	83.1	9.9	2.9	1.8	0.8	0.5	0.5	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.9%
2003	84.2	9.5	2.5	1.6	0.7	0.5	0.4	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	15.8%
2004	85.9	8.8	2.3	1.4	0.6	0.4	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.1%
2005	84.5	10.2	2.4	1.4	0.6	0.4	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.5%
2006	85.6	9.8	2.1	1.3	0.5	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.5%
2007	86.2	9.1	2.1	1.4	0.5	0.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8%
2008	87.5	8.3	2.2	1.1	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5%
2009	86.0	9.2	2.2	1.4	0.6	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0%
2010	87.1	8.2	2.2	1.4	0.5	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.9%
2011	87.5	8.3	2.1	1.1	0.5	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5%
2012	88.2	7.8	2.1	1.1	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.8%
2013	86.5	9.5	2.1	1.1	0.4	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5%
2014	85.2	10.8	2.1	1.1	0.5	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.9%
2015	85.4	10.4	2.3	1.1	0.4	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6%
2016	88.6	8.0	1.8	0.9	0.3	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4%
2017	90.2	7.1	1.5	0.8	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.8%
2018	90.3	6.9	1.6	0.7	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.7%
2019	90.4	6.9	1.5	0.7	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6%
2020	90.2	6.9	1.5	0.8	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.8%
2021	93.4	4.4	1.3	0.5	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6%

LLD：Lower limit of detection

(8) Statistics of the Number of Radiation Workers with Personal Annual Dose over 20 mSv Nationwide

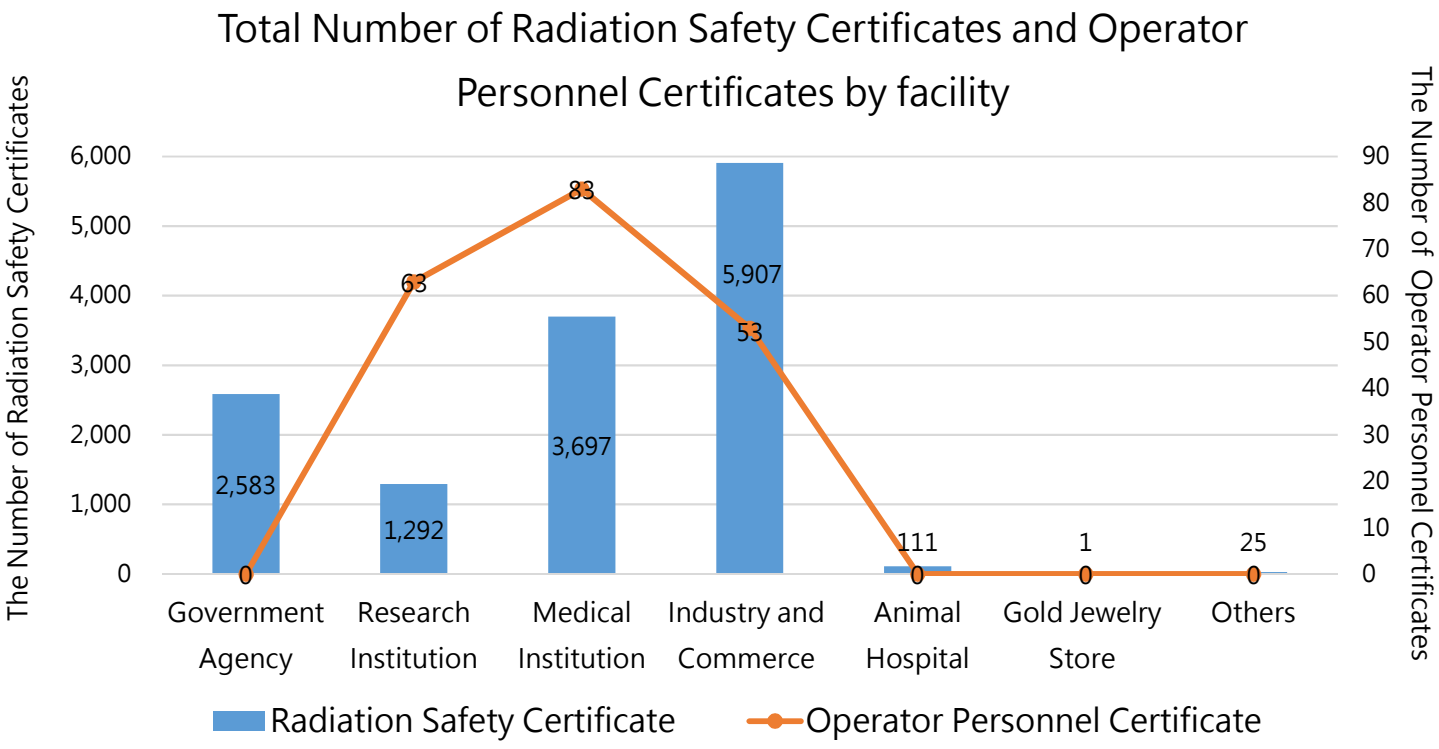
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
More than 20 mSv	101	81	55	80	4	8	20	6	1	0	0	0	1	1	0	0	0	0	2	0	6	0
More than 50 mSv	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



4. Personnel with Certificates (Radiation Safety Certificates, Operator Personnel, Radiation Protection Personnel) and Radiation Protection Business with Certificates

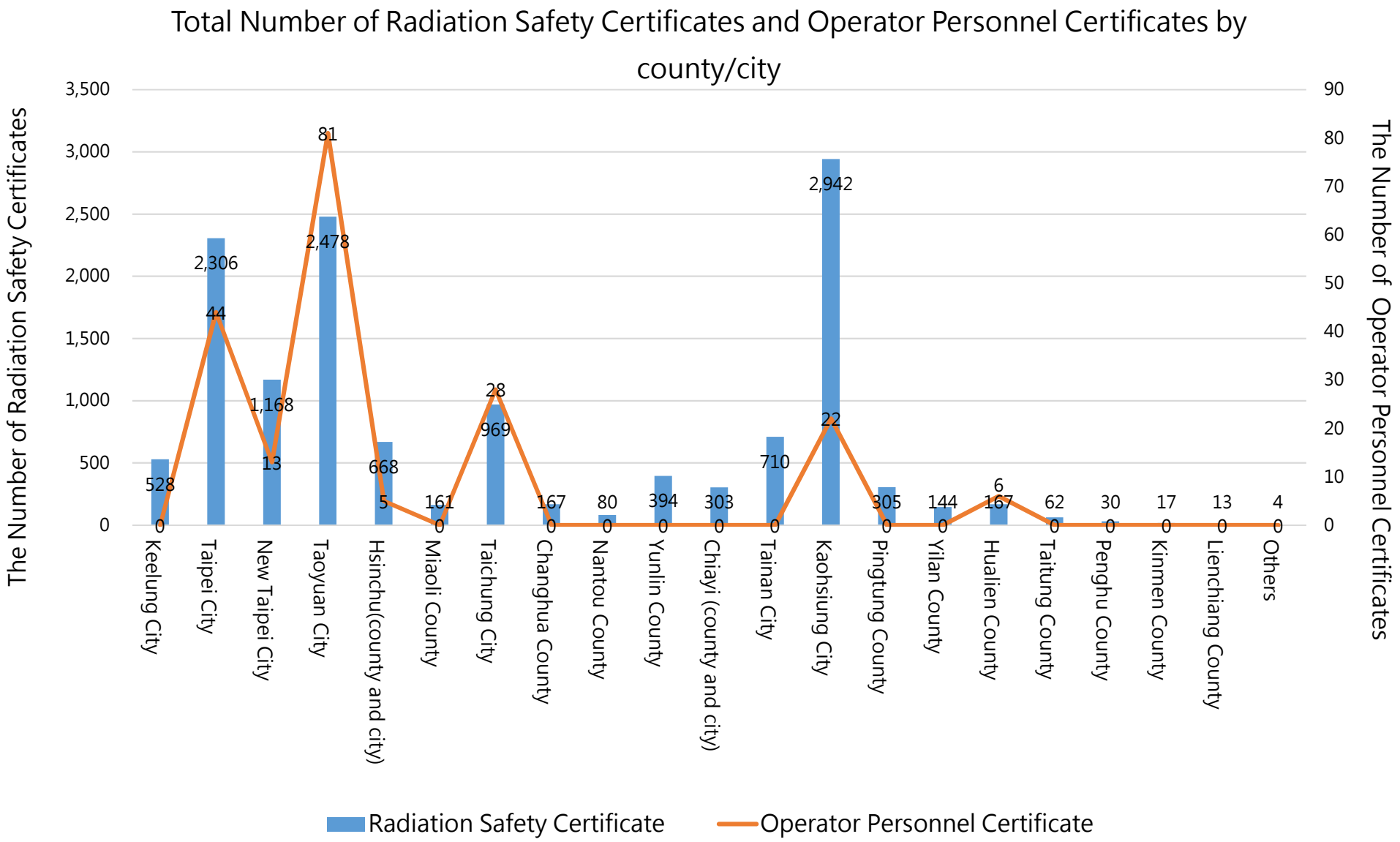
(1) Total Number of Radiation Safety Certificates and Operator Personnel Certificates by facility

Facility / Certificate Type	Government Agency	Research Institution	Medical Institution	Industry and Commerce	Animal Hospital	Gold Jewelry Store	Others (Including unemployed people)	Total
Radiation Safety Certificate	2,583	1,292	3,697	5,907	111	1	25	13,616
Operator Personnel Certificate	0	63	83	53	0	0	0	199
Total	2,583	1,355	3,780	5,960	111	1	25	13,815



(2) Total Number of Radiation Safety Certificates and Operator Personnel Certificates by county/city

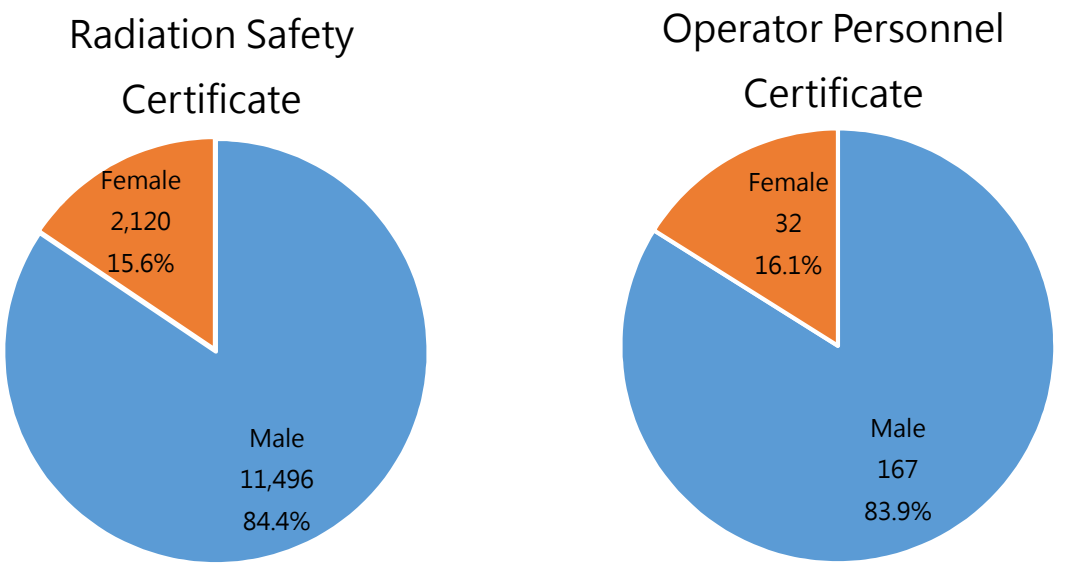
Certificate type / County/City	Radiation Safety Certificate	Operator Personnel Certificate	Total
Keelung City	528	0	528
Taipei City	2,306	44	2,350
New Taipei City	1,168	13	1,181
Taoyuan City	2,478	81	2,559
Hsinchu(county and city)	668	5	673
Miaoli County	161	0	161
Taichung City	969	28	997
Changhua County	167	0	167
Nantou County	80	0	80
Yunlin County	394	0	394
Chiayi (county and city)	303	0	303
Tainan City	710	0	710
Kaohsiung City	2,942	22	2,964
Pingtung County	305	0	305
Yilan County	144	0	144
Hualien County	167	6	173
Taitung County	62	0	62
Penghu County	30	0	30
Kinmen County	17	0	17
Lienchiang County	13	0	13
Others	4	0	4
Total	13,616	199	13,815


Total Number of Radiation Safety Certificates and Operator Personnel Certificates by county/city
The Number of Radiation Safety Certificates
The Number of Operator Personnel Certificates
3,500
3,000
2,500
2,000
1,500
1,000
500
0
90
80
70
60
50
40
30
20
10
0
528
0
2,306
44
1,168
13
2,478
81
668
5
161
0
969
28
167
0
80
0
394
0
303
0
710
0
2,942
22
305
0
144
0
167
6
62
0
30
0
17
0
13
0
4
0
Keelung City
Taipei City
New Taipei City
Taoyuan City
Hsinchu(county and city)
Miaoli County
Taichung City
Changhua County
Nantou County
Yunlin County
Chiayi (county and city)
Tainan City
Kaohsiung City
Pingtung County
Yilan County
Hualien County
Taitung County
Penghu County
Kinmen County
Lienchiang County
Others
Radiation Safety Certificate
Operator Personnel Certificate

(3) Total Number of Radiation Safety Certificates and Operator Personnel Certificates by gender

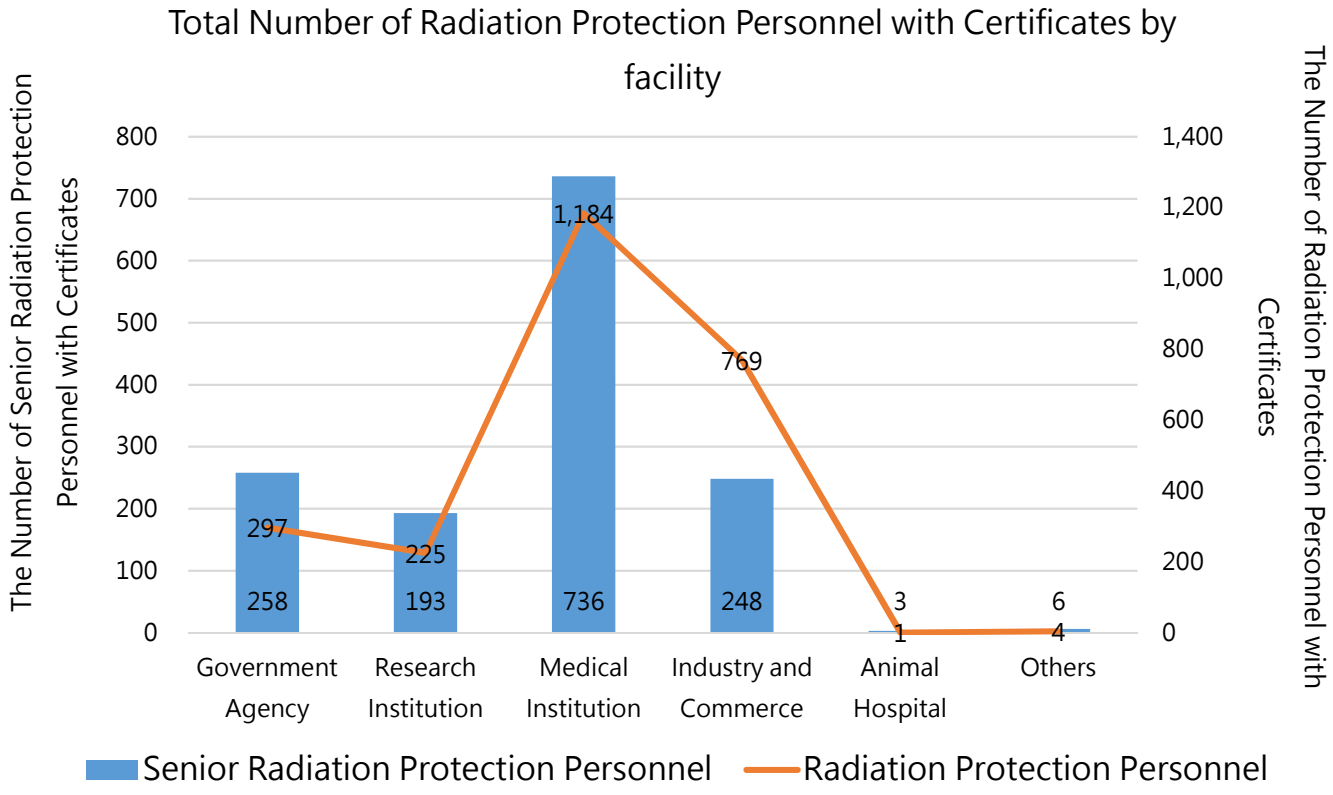
Gender / Certificate Type	Male	Female	Total	Male Ratio	Female Ratio
Radiation Safety Certificate	11,496	2,120	13,616	84.4%	15.6%
Operator Personnel Certificate	167	32	199	83.9%	16.1%
Total	11,663	2,152	13,815	84.4%	15.6%

Total Number of Radiation Safety Certificates and Operator Personnel Certificates by gender



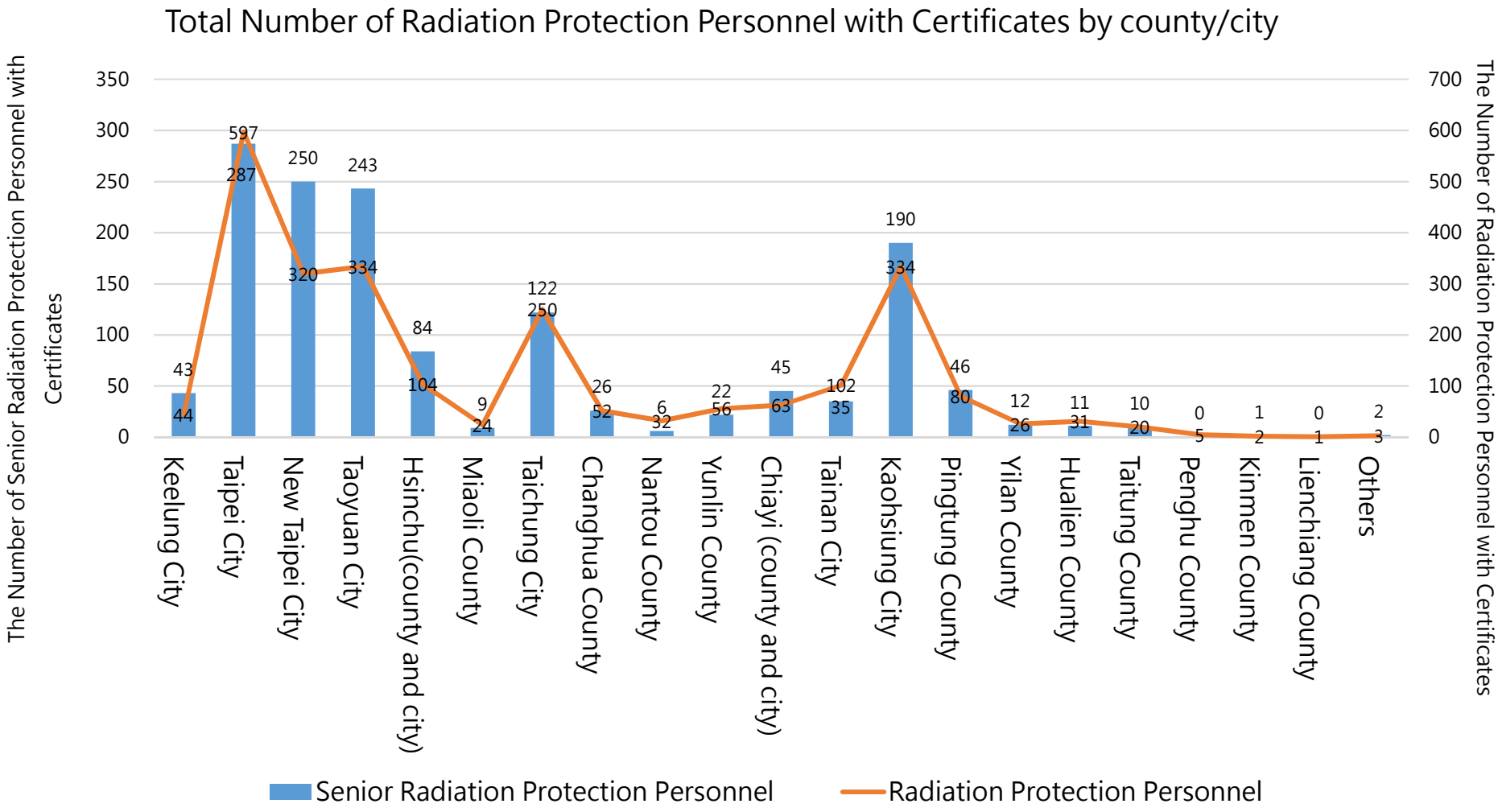
(4) Total Number of Radiation Protection Personnel with Certificates by facility

Facility / Certificate Type	Government Agency	Research Institution	Medical Institution	Industry and Commerce	Animal Hospital	Others (Including unemployed people)	Total
Senior Radiation Protection Personnel	258	193	736	248	3	6	1,444
Radiation Protection Personnel	297	225	1,184	769	1	4	2,480
Total	555	418	1,920	1,017	4	10	3,924



(5) Total Number of Radiation Protection Personnel with Certificates by county/city

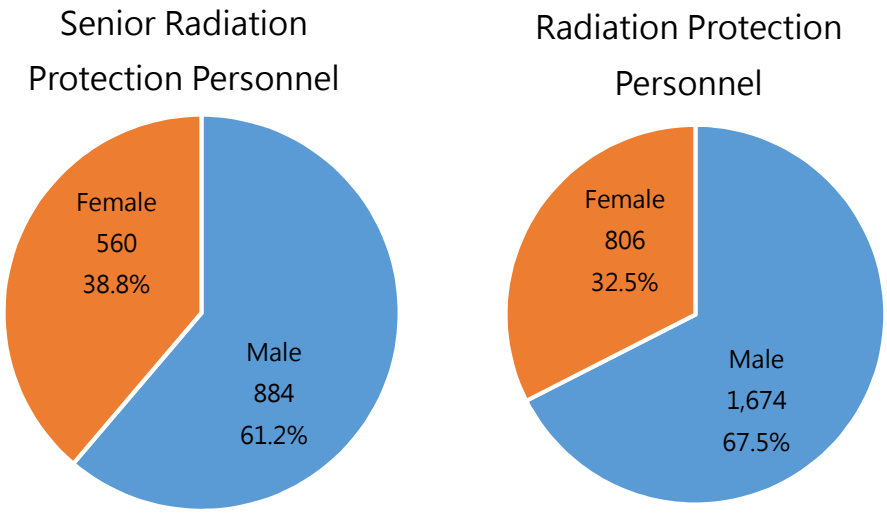
Certificate Type / County/City	Senior Radiation Protection Personnel	Radiation Protection Personnel	Total
Keelung City	43	44	87
Taipei City	287	597	884
New Taipei City	250	320	570
Taoyuan City	243	334	577
Hsinchu(county and city)	84	104	188
Miaoli County	9	24	33
Taichung City	122	250	372
Changhua County	26	52	78
Nantou County	6	32	38
Yunlin County	22	56	78
Chiayi (county and city)	45	63	108
Tainan City	35	102	137
Kaohsiung City	190	334	524
Pingtung County	46	80	126
Yilan County	12	26	38
Hualien County	11	31	42
Taitung County	10	20	30
Penghu County	0	5	5
Kinmen County	1	2	3
Lienchiang County	0	1	1
Others	2	3	5
Total	1,444	2,480	3,924


Total Number of Radiation Protection Personnel with Certificates by county/city
The Number of Senior Radiation Protection Personnel with Certificates
The Number of Radiation Protection Personnel with Certificates
350
300
250
200
150
100
50
0
700
600
500
400
300
200
100
0
Keelung City 43 44
Taipei City 287 597
New Taipei City 250 320
Taoyuan City 243 334
Hsinchu(county and city) 84 104
Miaoli County 9 24
Taichung City 122 250
Changhua County 26 52
Nantou County 6 32
Yunlin County 22 56
Chiayi (county and city) 45 63
Tainan City 102 35
Kaohsiung City 190 334
Pingtung County 46 80
Yilan County 12 26
Hualien County 11 31
Taitung County 10 20
Penghu County 0 5
Kinmen County 1 2
Lienchiang County 0 1
Others 2 3
Senior Radiation Protection Personnel
Radiation Protection Personnel

(6) Total Number of Radiation Protection Personnel with Certificates by gender

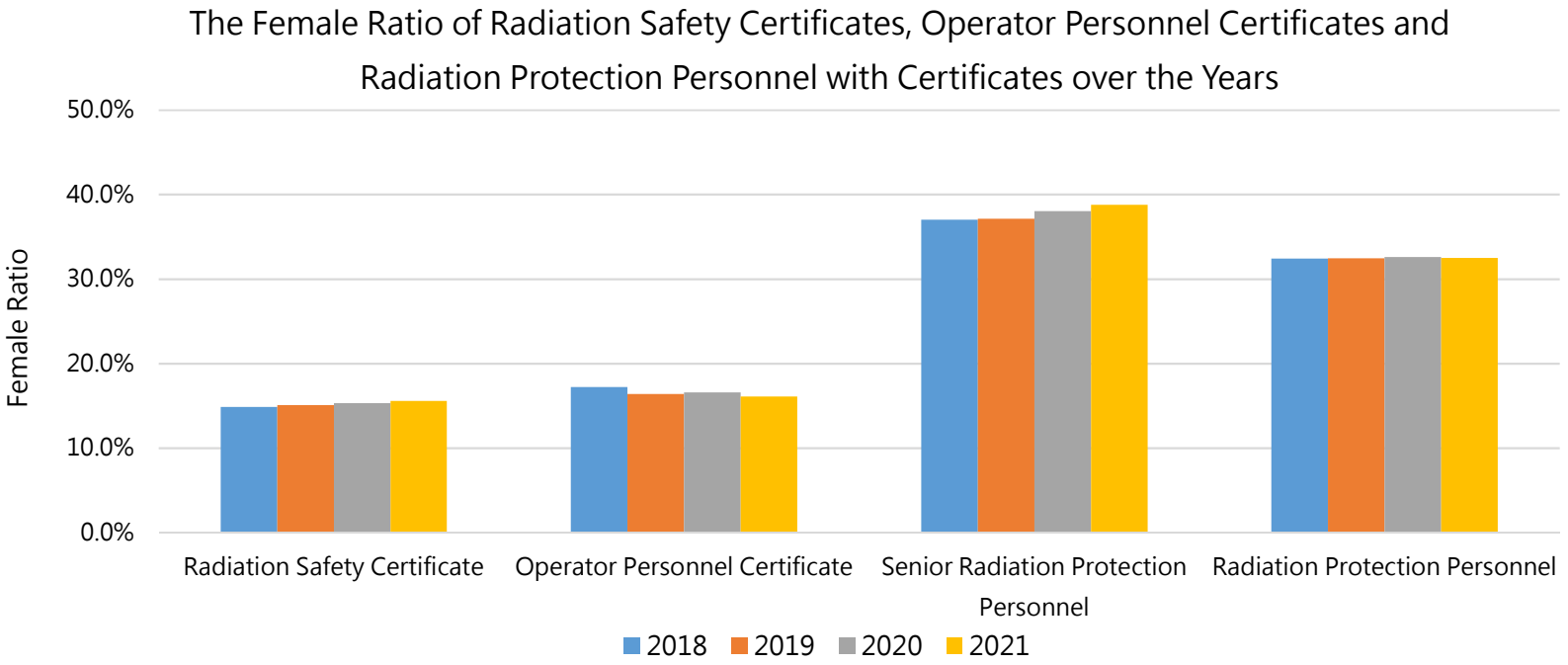
Gender / Certificate Type	Male	Female	Total	Male Ratio	Female Ratio
Senior Radiation Protection Personnel	884	560	1,444	61.2%	38.8%
Radiation Protection Personnel	1,674	806	2,480	67.5%	32.5%
Total	2,558	1,366	3,924	65.2%	34.8%

Total Number of Radiation Protection Personnel with Certificates by gender



(7) The Female Ratio of Radiation Safety Certificates, Operator Personnel Certificates and Radiation Protection Personnel with Certificates over the Years

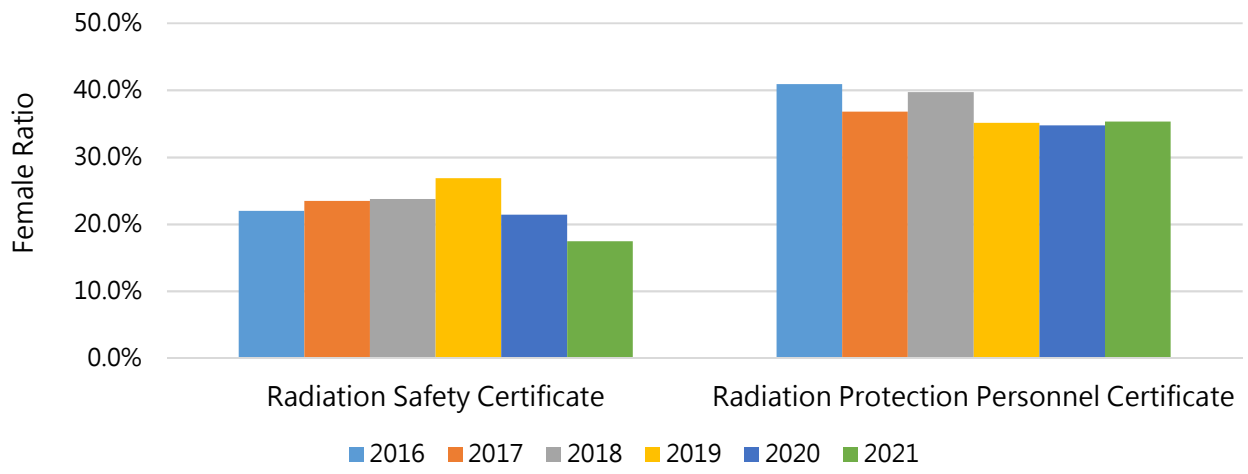
	Radiation Safety Certificate			Operator Personnel Certificate			Senior Radiation Protection Personnel			Radiation Protection Personnel		
Year	Male	Female	Female Ratio	Male	Female	Female Ratio	Male	Female	Female Ratio	Male	Female	Female Ratio
2018	11,200	1,956	14.9%	130	27	17.2%	816	480	37.0%	1,667	799	32.4%
2019	11,279	2,000	15.1%	148	29	16.4%	850	502	37.1%	1,676	805	32.4%
2020	11,395	2,061	15.3%	151	30	16.6%	868	533	38.0%	1,669	808	32.6%
2021	11,496	2,120	15.6%	167	32	16.1%	884	560	38.8%	1,674	806	32.5%



(8) Number of Applications for Radiation Safety Certificates and Radiation Protection Personnel Certificates in the Past 6 years

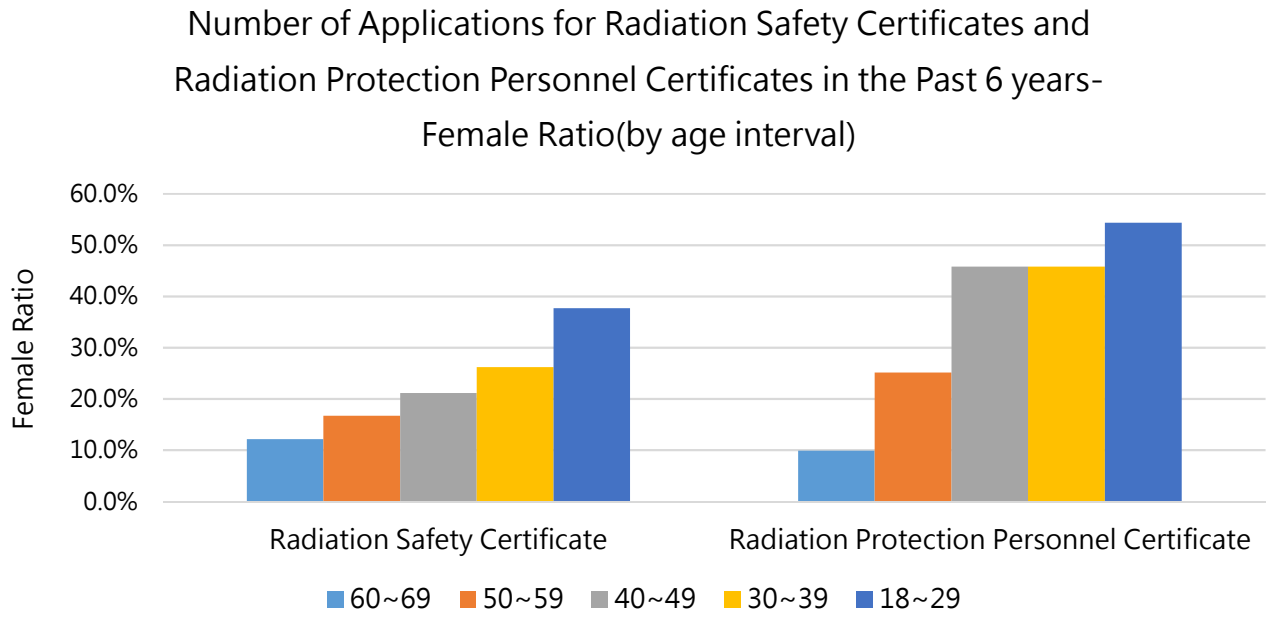
	Year	Female	Male	Total	Female Ratio	Male Ratio
Radiation Safety Certificate	2016	143	507	650	22.0%	78.0%
	2017	129	420	549	23.5%	76.5%
	2018	133	427	560	23.8%	76.3%
	2019	163	444	607	26.9%	73.1%
	2020	190	696	886	21.4%	78.6%
	2021	186	879	1,065	17.5%	82.5%
Total		944	3,373	4,317	21.9%	78.1%
Average		157	562	720	22.5%	77.5%
Radiation Protection Personnel Certificate	2016	148	214	362	40.9%	59.1%
	2017	78	134	212	36.8%	63.2%
	2018	79	120	199	39.7%	60.3%
	2019	84	155	239	35.1%	64.9%
	2020	193	362	555	34.8%	65.2%
	2021	258	472	730	35.3%	64.7%
Total		840	1,457	2,297	36.6%	63.4%
Average		140	243	383	37.1%	62.9%

Number of Applications for Radiation Safety Certificates and Radiation Protection Personnel Certificates in the Past 6 years-Female Ratio



(9) Number of Applications for Radiation Safety Certificates and Radiation Protection Personnel Certificates in the Past 6 years by age interval and gender

	Age Interval	Female	Male	Total	Female Ratio	Male Ratio
Radiation Safety Certificate	80~88	0	5	5	0.0%	100.0%
	70~79	0	17	17	0.0%	100.0%
	60~69	48	347	395	12.2%	87.8%
	50~59	175	871	1,046	16.7%	83.3%
	40~49	289	1,077	1,366	21.2%	78.8%
	30~39	294	828	1,122	26.2%	73.8%
	18~29	138	228	366	37.7%	62.3%
	Total	944	3,373	4,317	21.9%	78.1%
Radiation Protection Personnel Certificate	80~88	0	4	4	0.0%	100.0%
	70~79	0	18	18	0.0%	100.0%
	60~69	27	246	273	9.9%	90.1%
	50~59	141	420	561	25.1%	74.9%
	40~49	306	362	668	45.8%	54.2%
	30~39	291	344	635	45.8%	54.2%
	18~29	75	63	138	54.3%	45.7%
	Total	840	1,457	2,297	36.6%	63.4%

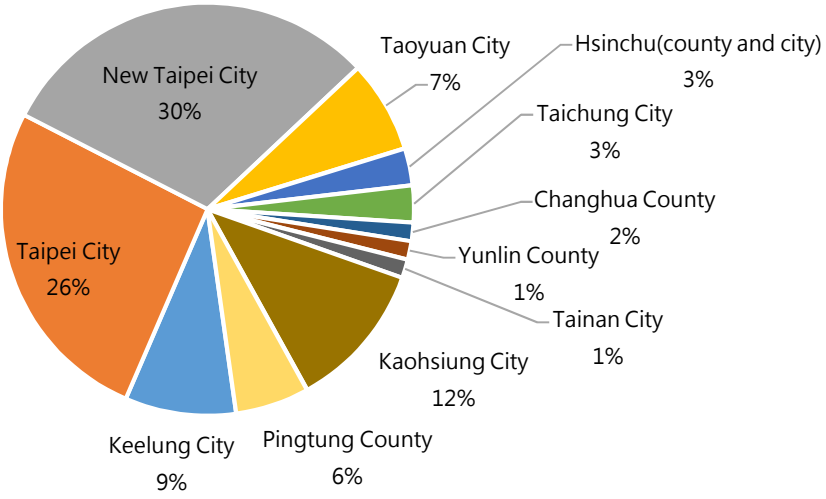


(10) Total Number of Radiation Protection Business with Certificates by business category and county/city

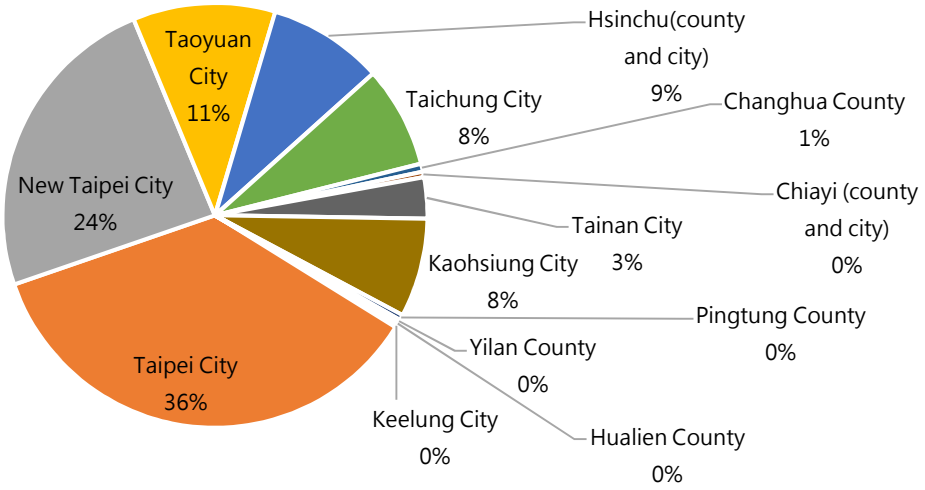
Business category / County/City	Radiation Protection Detection Businesses	Radiation Protection Service Businesses	Institutions of Radiation Protection Training Affairs	Total
Keelung City	6	1	1	8
Taipei City	18	172	1	191
New Taipei City	21	115	5	141
Taoyuan City	5	52	3	60
Hsinchu(county and city)	2	42	5	49
Miaoli County	0	0	0	0
Taichung City	2	37	2	41
Changhua County	1	3	1	5
Nantou County	0	0	0	0
Yunlin County	1	0	0	1
Chiayi (county and city)	0	2	0	2
Tainan City	1	15	2	18
Kaohsiung City	8	36	2	46
Pingtung County	4	2	0	6
Yilan County	0	1	1	2
Hualien County	0	1	0	1
Taitung County	0	0	0	0
Penghu County	0	0	0	0
Kinmen County	0	0	0	0
Lienchiang County	0	0	0	0
Total	69	479	23	571

Total Number of Radiation Protection Business with Certificates by business category and county/city

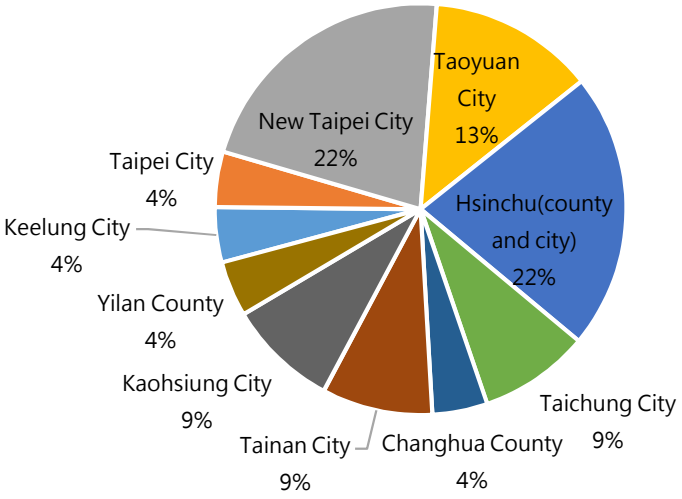
Radiation Protection Detection Businesses



Radiation Protection Service Businesses



Institutions of Radiation Protection Training Affairs



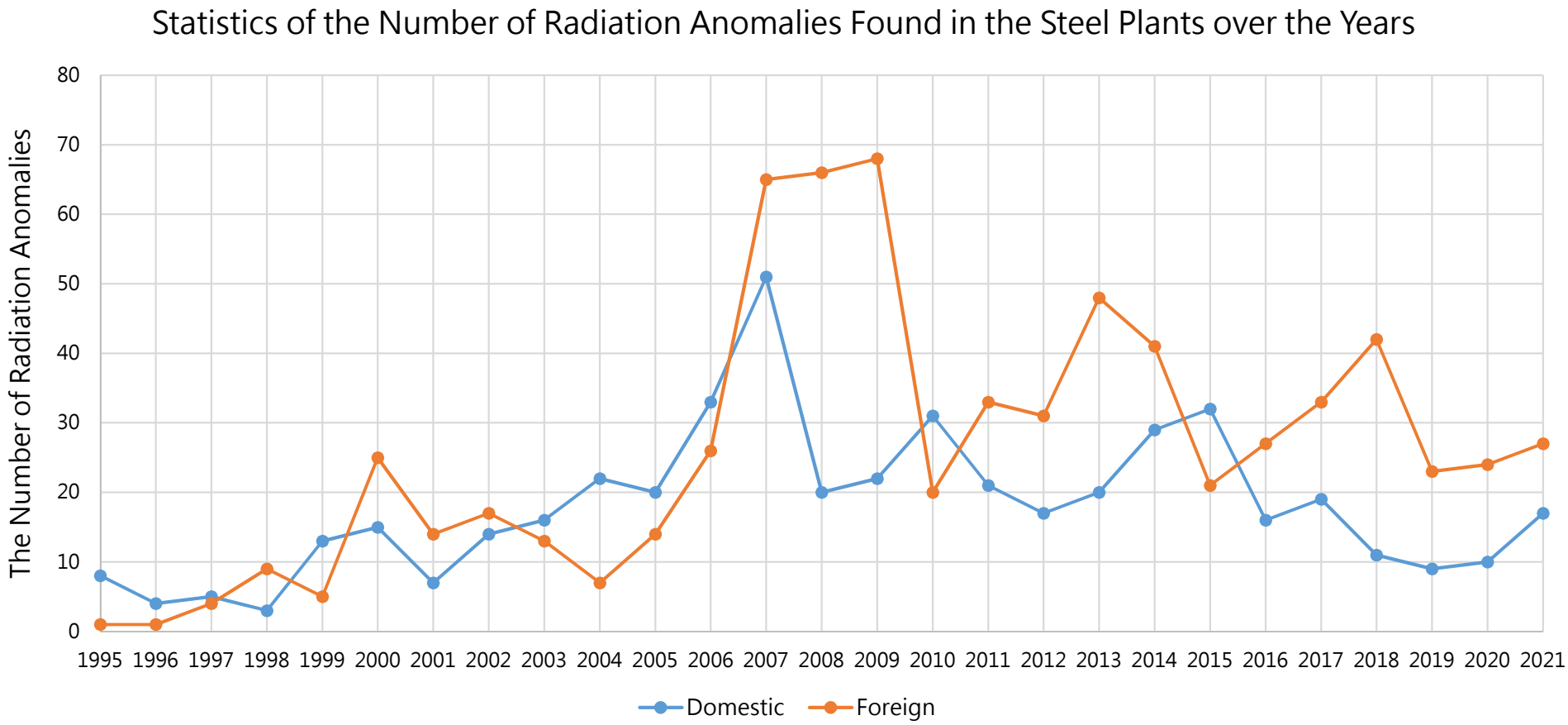
5. Radiation Anomalies Found in the Steel Plants over the Years

(1) Statistics of the Number of Radiation Anomalies Found in the Steel Plants over the Years

Year / Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Domestic	8	4	5	3	13	15	7	14	16	22	20
Foreign	1	1	4	9	5	25	14	17	13	7	14
Total	9	5	9	12	18	40	21	31	29	29	34

Year / Source	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Domestic	33	51	20	22	31	21	17	20	29	32	16
Foreign	26	65	66	68	20	33	31	48	41	21	27
Total	59	116	86	90	51	54	48	68	70	53	43

Year / Source	2017	2018	2019	2020	2021	Total
Domestic	19	11	9	10	17	485
Foreign	33	42	23	24	27	705
Total	52	53	32	34	44	1,190

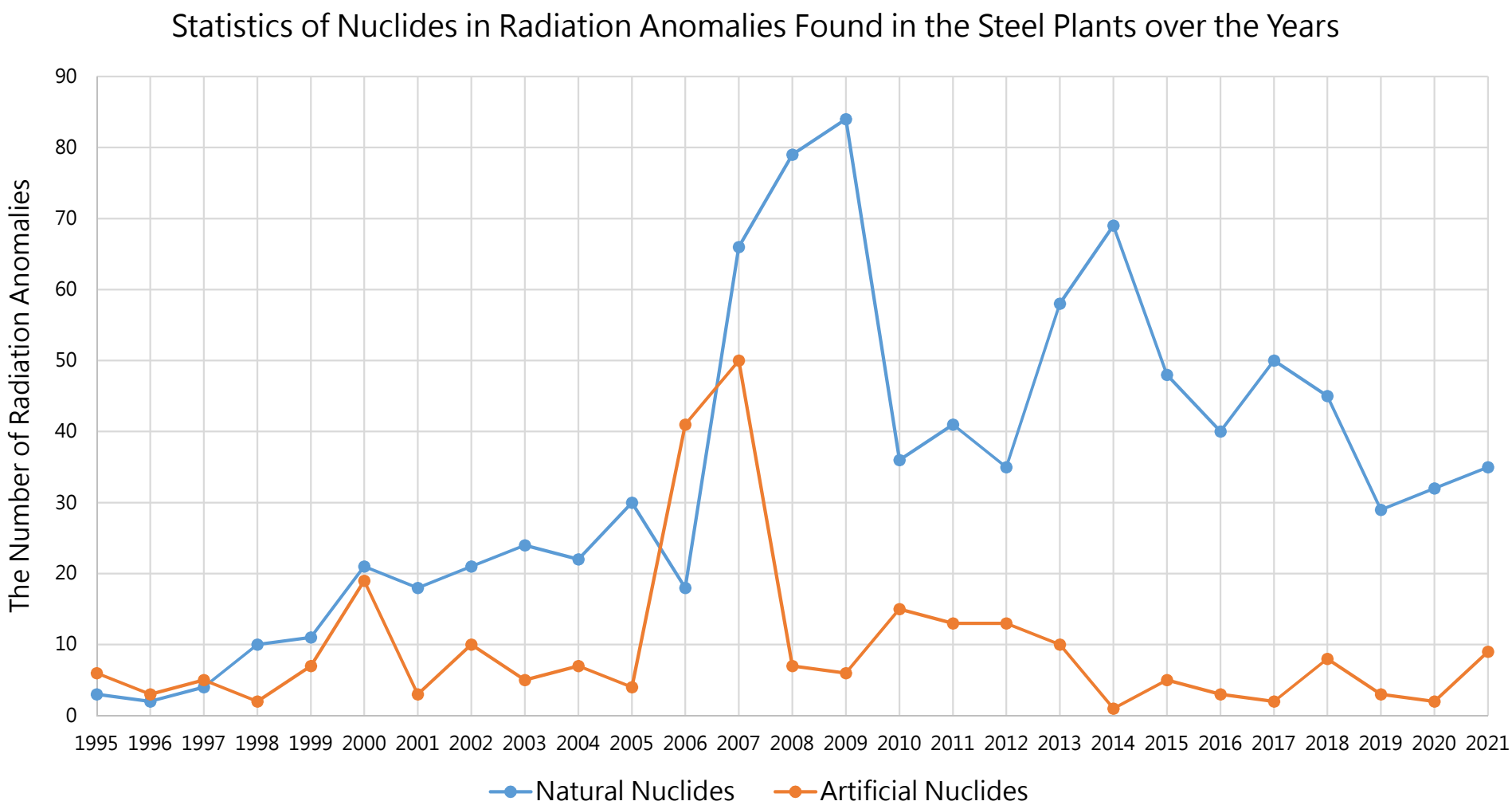

Statistics of the Number of Radiation Anomalies Found in the Steel Plants over the Years
The Number of Radiation Anomalies
80
70
60
50
40
30
20
10
0
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Domestic
Foreign

(2) Statistics of Nuclides in Radiation Anomalies Found in the Steel Plants over the Years

Year / Nuclides	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Natural Nuclides	3	2	4	10	11	21	18	21	24	22	30
Artificial Nuclides	6	3	5	2	7	19	3	10	5	7	4
Total	9	5	9	12	18	40	21	31	29	29	34

Year / Nuclides	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Natural Nuclides	18	66	79	84	36	41	35	58	69	48	40
Artificial Nuclides	41	50	7	6	15	13	13	10	1	5	3
Total	59	116	86	90	51	54	48	68	70	53	43

Year / Nuclides	2017	2018	2019	2020	2021	Total
Natural Nuclides	50	45	29	32	35	931
Artificial Nuclides	2	8	3	2	9	259
Total	52	53	32	34	44	1,190


Statistics of Nuclides in Radiation Anomalies Found in the Steel Plants over the Years
The Number of Radiation Anomalies
90
80
70
60
50
40
30
20
10
0
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Natural Nuclides
Artificial Nuclides

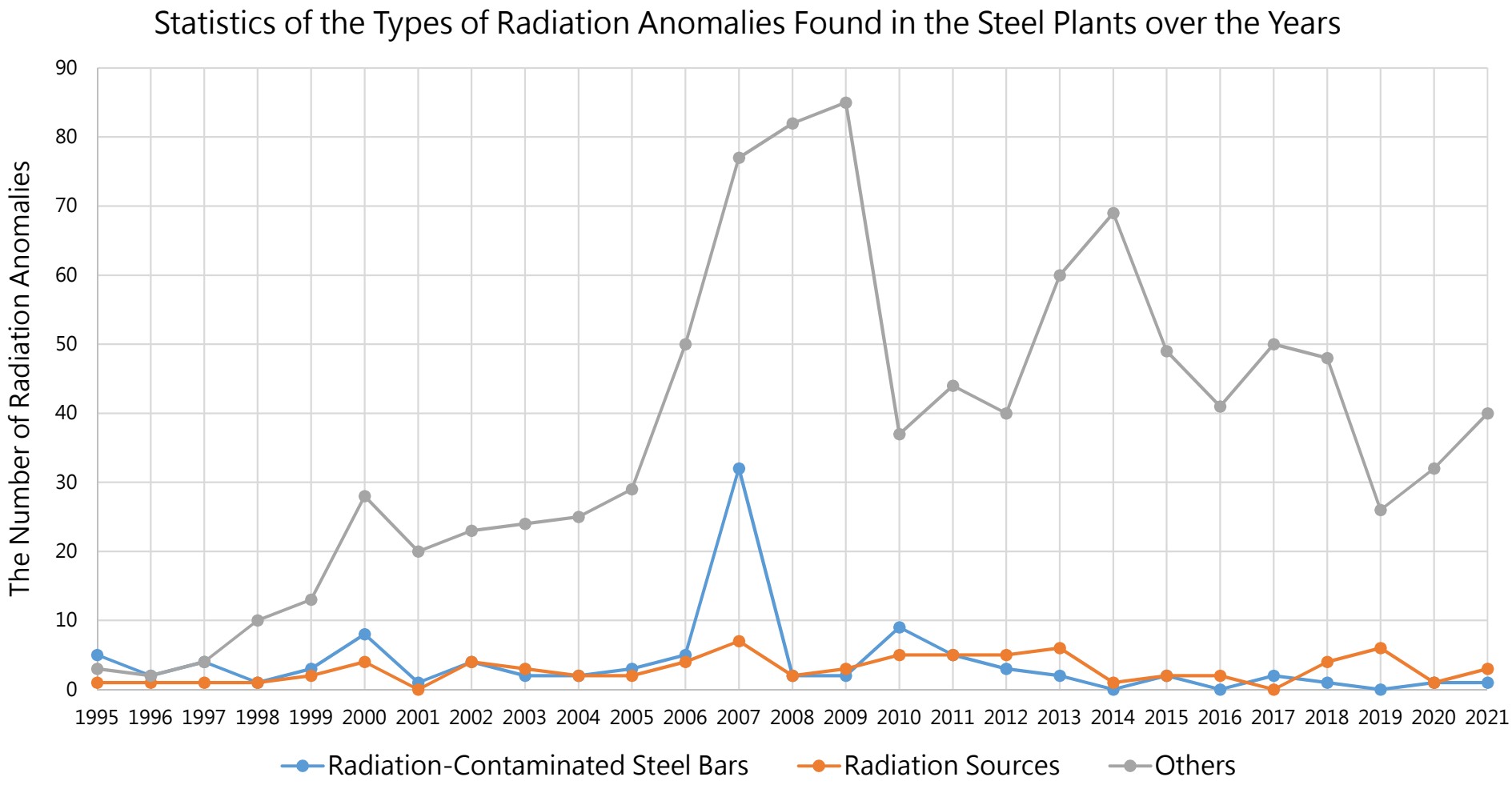
(3) Statistics of the Types of Radiation Anomalies Found in the Steel Plants over the Years

Year / Types of Radiation Anomalies	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Radiation-Contaminated Steel Bars	5	2	4	1	3	8	1	4	2	2	3
Radiation Sources	1	1	1	1	2	4	0	4	3	2	2
Others*	3	2	4	10	13	28	20	23	24	25	29
Total	9	5	9	12	18	40	21	31	29	29	34

Year / Types of Radiation Anomalies	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Radiation-Contaminated Steel Bars	5	32	2	2	9	5	3	2	0	2	0
Radiation Sources	4	7	2	3	5	5	5	6	1	2	2
Others*	50	77	82	85	37	44	40	60	69	49	41
Total	59	116	86	90	51	54	48	68	70	53	43

Year / Types of Radiation Anomalies	2017	2018	2019	2020	2021	Total
Radiation-Contaminated Steel Bars	2	1	0	1	1	102
Radiation Sources	0	4	6	1	3	77
Others*	50	48	26	32	40	1,011
Total	52	53	32	34	44	1,190

* "Others" refers to those that are difficult to classify, and most are naturally occurring radioactive materials.


Statistics of the Types of Radiation Anomalies Found in the Steel Plants over the Years
The Number of Radiation Anomalies
90
80
70
60
50
40
30
20
10
0
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Radiation-Contaminated Steel Bars
Radiation Sources
Others