

Statistics of Ionizing Radiation Applications and Management



Atomic Energy Council
2021/07

PreFace

As technology rapidly advances and develops, applications for radiation have been widely adopted in medicine, agriculture, industry, and research. Consequently, radioactive materials and equipment capable of producing ionizing radiation, radiation personnel, and operator personnel are in great demand to lead the vital management of radiation safety. The Atomic Energy Council's (AEC) *Ionizing Radiation Protection Act (the IRP Act)* has been in place since February, 2003. Its enforcement rules and the related 23 regulations were sequentially promulgated and implemented, making the IRP Act more refined and comprehensive.

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

These statistical data are based on medical and non-medical licenses. Licenses issued in Taiwan for radioactive materials and equipment capable of producing ionizing radiation are statistically categorized according to counties/cities, facilities, types of equipment, and radioactive materials. Altogether 34,151 licenses have been issued, of which 21,283 are for medical use and 12,868 for non-medical use. Additionally, this report includes personal dose of radiation workers nationwide, as well as statistical data such as radiation protection personnel, operator personnel, and radiation safety certificate and radiation anomalies in Taiwan.

Statistics have been compiled through the end of 2020, and will be updated

annually. Should there be any missing data, please kindly advise us.

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1. Medical Use

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

Institution County/City	Permit						Registration					
	Public Medical Institutions			Private Medical Institutions			Public Medical Institutions			Private Medical Institutions		
	Equipm ent	Seale d	Unseal ed	Equipm ent	Seale d	Unseal ed	Equipm ent	Seale d	Unseal ed	Equipm ent	Seale d	Unseal ed
Keelung City	0	0	0	2	0	2	38	0	0	225	2	0
Taipei City	20	8	11	15	6	10	502	76	0	3,283	39	2
New Taipei City	0	0	1	19	7	9	102	1	0	2,859	33	0
Taoyuan City	2	1	2	13	3	7	116	4	0	1,613	30	0
Hsinchu(county and city)	1	1	1	4	1	2	98	3	0	757	10	0
Miaoli County	1	0	0	1	0	1	27	0	0	333	2	0
Taichung City	7	4	4	20	7	10	188	9	0	2,618	32	0
Changhua County	1	0	0	6	3	3	22	0	0	829	8	0
Nantou County	1	0	1	1	0	0	45	0	0	259	0	0
Yunlin County	2	1	2	2	0	1	69	6	0	315	0	0
Chiayi (county and city)	1	1	1	8	3	4	75	0	0	545	16	0
Tainan City	3	2	1	11	2	4	135	8	0	1,399	10	0
Kaohsiung City	7	2	3	21	6	7	237	3	0	2,367	28	0
Pingtung County	1	0	0	4	1	2	51	0	0	454	1	0
Yilan County	1	0	1	3	0	1	74	1	0	300	4	0
Hualien County	0	0	0	3	3	3	85	0	0	250	12	0
Taitung County	0	0	0	2	0	1	43	0	0	116	0	0
Penghu County	0	0	0	0	0	0	44	0	0	46	0	0
Kinmen County	0	0	0	0	0	0	21	0	0	0	0	0
Lienchiang County	0	0	0	0	0	0	22	0	0	41	0	0
Total	48	20	28	135	42	67	1,994	111	0	18,609	227	2

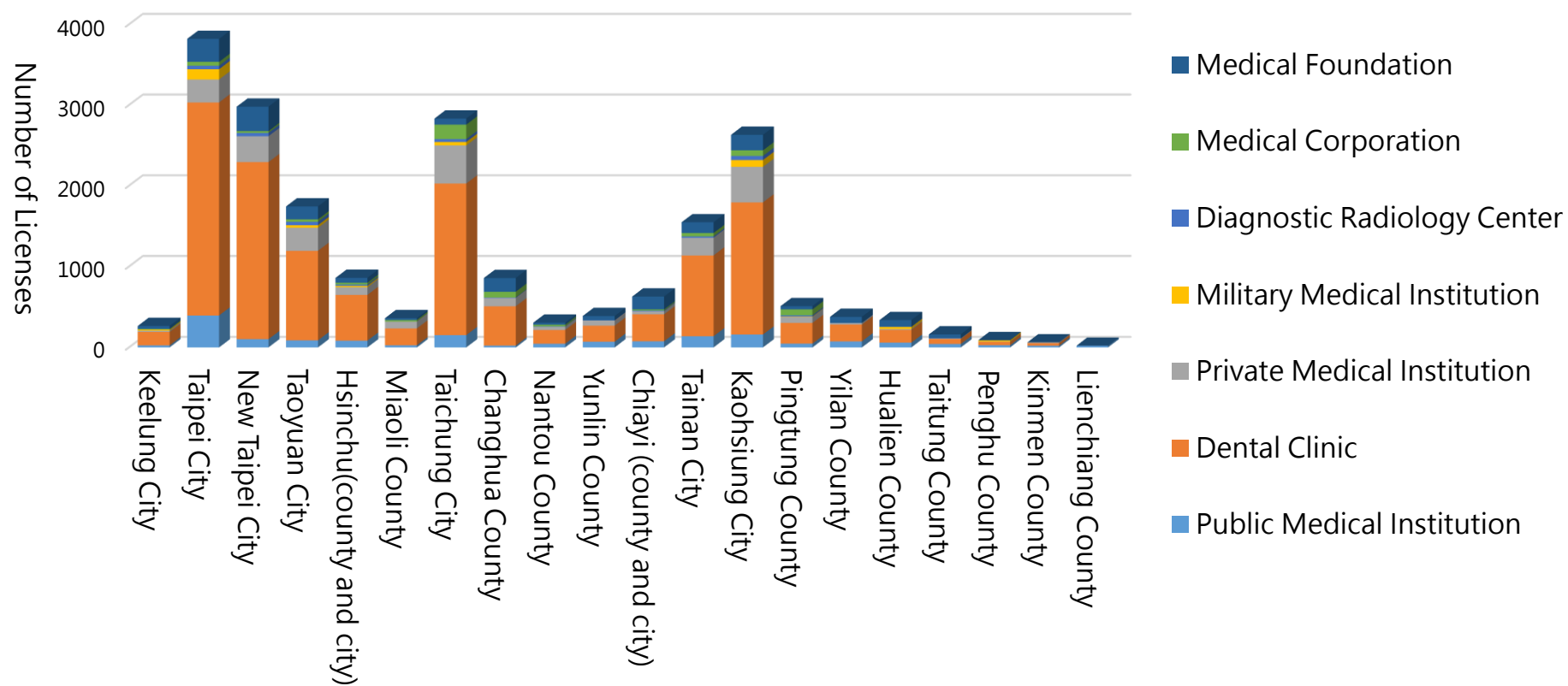
Remarks:

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 – per 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	25	166	16	13	1	7	37	265
Taipei City	395	2,637	285	127	43	48	285	3,820
New Taipei City	102	2,191	321	0	41	22	303	2,980
Taoyuan City	87	1,107	286	31	42	31	160	1,744
Hsinchu(county and city)	84	565	96	16	15	23	61	860
Miaoli County	27	208	85	0	0	19	23	362
Taichung City	152	1,876	472	43	35	180	75	2,833
Changhua County	23	486	103	0	6	70	170	858
Nantou County	46	170	40	0	4	20	26	306
Yunlin County	71	198	64	0	3	0	52	388
Chiayi (county and city)	76	333	39	0	7	14	160	629
Tainan City	138	999	219	0	16	43	133	1,548
Kaohsiung City	160	1,634	441	84	51	69	193	2,632
Pingtung County	47	256	74	5	15	73	40	510
Yilan County	75	208	19	0	1	0	75	378
Hualien County	59	158	10	26	3	0	82	338
Taitung County	43	62	7	0	2	0	47	161
Penghu County	28	40	4	16	0	0	2	90
Kinmen County	22	31	10	0	0	0	0	63
Lienchiang County	21	0	0	0	0	0	0	21
Total	1,681	13,325	2,591	361	285	619	1,924	20,786

Number of Licenses for All Types of Medical Institution Installed with Equipment
Capable of Producing Ionizing Radiation

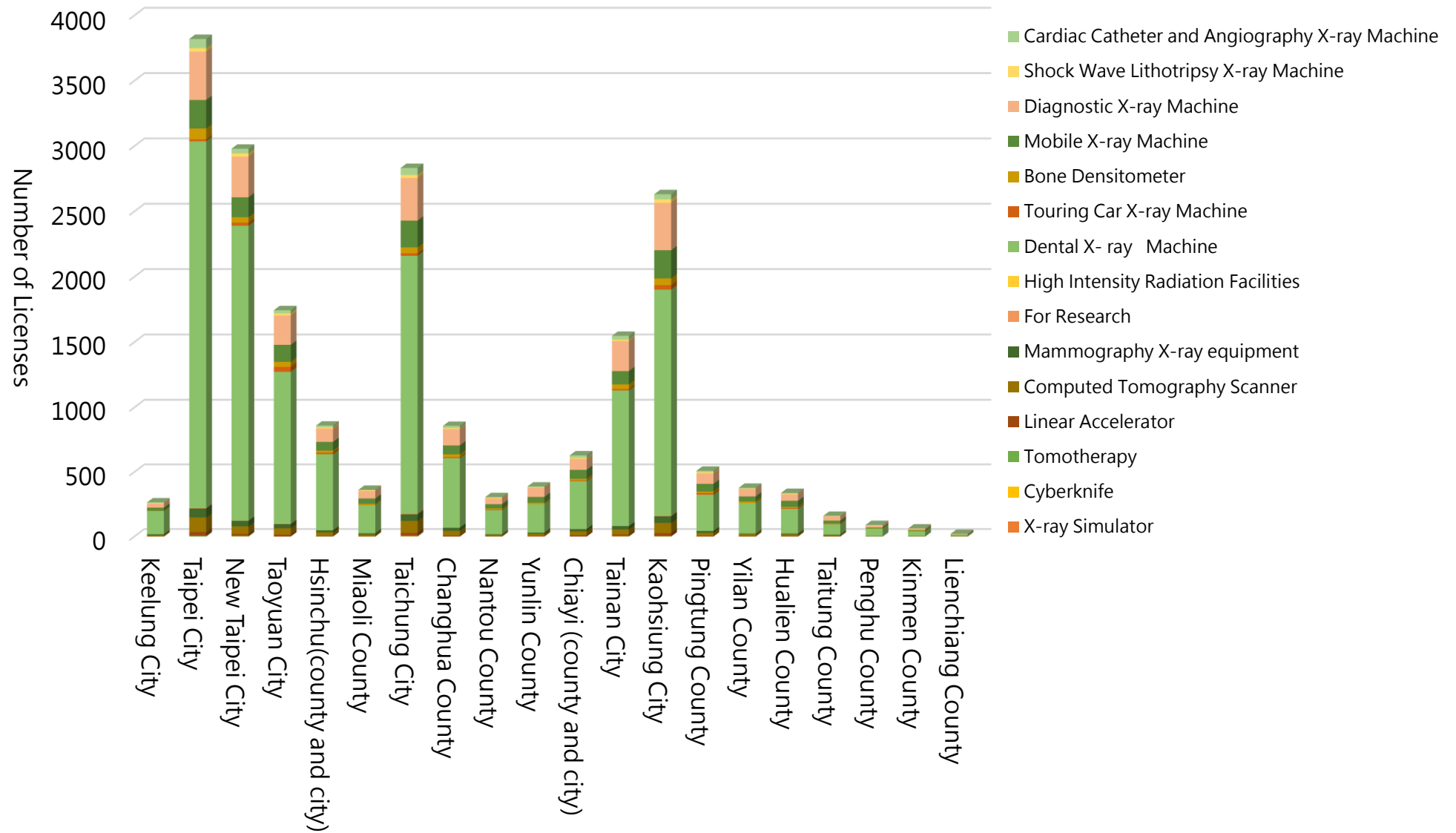


(3) Number of Licenses for All Types of Medical Equipment Capable of Producing Ionizing Radiation – per county/city

Equipment County/City	X-ray Simulator	Cyberknife	Tomotherapy	Linear Accelerator	Computed Tomography Scanner	Mammography X-ray equipment	For Research	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	9	7	0	0	179	0	3	24	32	5	4	265
Taipei City	0	0	7	28	113	70	6	0	2,813	15	83	218	370	27	70	3,820
New Taipei City	1	1	4	14	59	43	1	0	2,268	23	42	152	311	25	36	2,980
Taoyuan City	0	0	0	14	50	33	3	1	1,172	38	38	130	225	16	24	1,744
Hsinchu(county and city)	0	0	1	4	27	16	0	0	590	12	16	67	104	10	13	860
Miaoli County	0	0	0	2	14	9	0	0	219	3	7	41	59	5	3	362
Taichung City	2	1	4	22	92	52	7	0	1,981	18	46	205	326	23	54	2,833
Changhua County	0	0	0	7	38	23	0	0	540	7	22	69	126	8	18	858
Nantou County	0	0	0	2	10	6	0	0	187	5	8	33	44	6	5	306
Yunlin County	1	0	0	4	16	9	0	0	221	0	11	45	71	5	5	388
Chiayi (county and city)	0	0	0	9	31	18	1	0	370	6	13	69	85	8	19	629
Tainan City	1	1	2	11	40	26	0	0	1,049	11	36	101	230	11	29	1,548

Kaohsiung City	0	1	2	24	79	52	6	1	1,737	34	52	215	363	27	39	2,632
Pingtung County	0	0	0	5	24	14	0	0	282	12	12	59	81	10	11	510
Yilan County	0	0	0	4	15	4	0	0	236	0	13	39	58	3	6	378
Hualien County	0	0	0	3	14	6	0	0	192	7	8	47	50	5	6	338
Taitung County	0	0	0	2	8	4	0	0	81	3	4	21	32	3	3	161
Penghu County	0	0	0	0	2	1	0	0	58	0	2	7	17	1	2	90
Kinmen County	0	0	0	0	2	1	0	0	37	1	5	5	10	1	1	63
Lienchiang County	0	0	0	0	2	1	0	0	10	0	0	2	6	0	0	21
Total	5	4	20	157	645	395	24	2	14,222	195	421	1,549	2,600	199	348	20,786

Number of Licenses for All Types of Medical Equipment Capable of Producing Ionizing Radiation

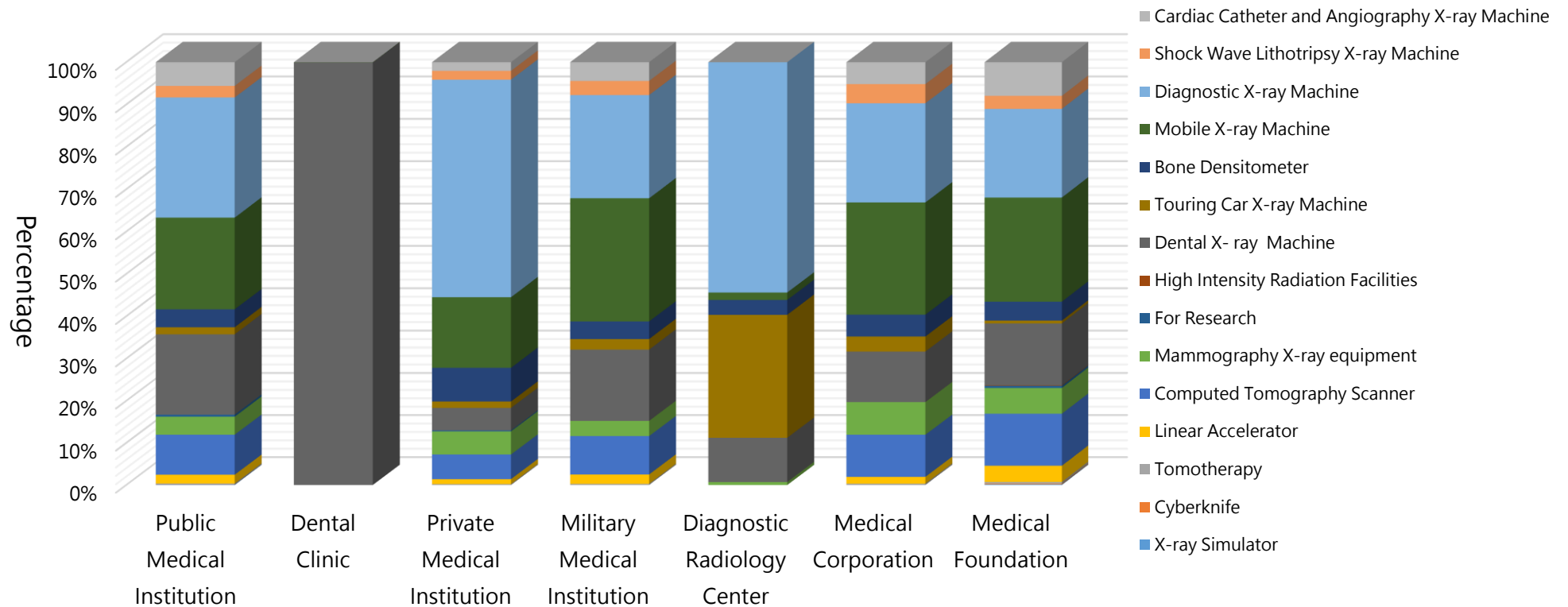


(4) Statistics of the Number of Licenses for All Types of Medical Institution Installed with All Kinds of Medical Equipment Capable of Producing Ionizing Radiation

Equipment Institution	X-ray Simulator	Cyberknife	Tomotherapy	Linear Accelerator	Computed Tomography Scanner	Mammography X-ray equipment	For Research	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
Public Medical Institution	2	1	3	35	160	72	8	0	320	28	71	364	477	46	94	1,681
Dental Clinic	0	0	0	0	0	0	0	0	13,317	1	0	6	1	0	0	13,325
Private Medical Institution	0	0	6	30	152	142	6	0	139	39	207	432	1,331	54	53	2,591
Military Medical Institution	0	0	1	8	33	13	0	0	61	9	15	105	88	12	16	361
Diagnostic Radiology Center	0	0	0	0	0	2	0	0	30	83	10	5	155	0	0	285
Medical Corporation	0	0	2	10	62	48	0	0	74	22	32	164	145	28	32	619
Medical Foundation	3	3	8	74	238	118	10	2	281	13	86	473	403	59	153	1,924
Total	5	4	20	157	645	395	24	2	14,222	195	421	1,549	2,600	199	348	20,786

Remarks: Equipment capable of producing ionizing radiation includes fixed type and touring type vehicle without biopsy.

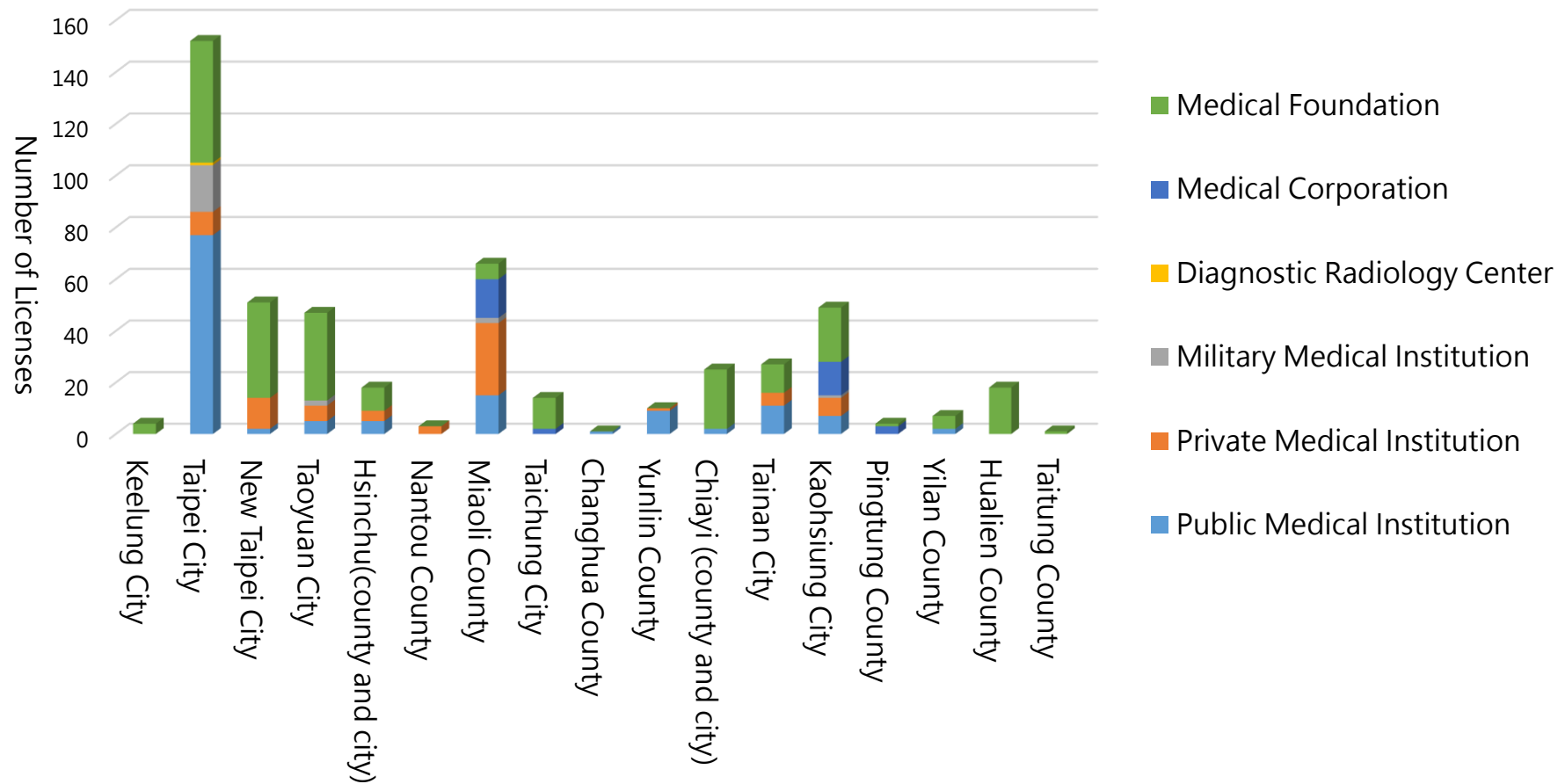
Statistics of the Number of Licenses for All Types of Medical Institution Installed with All Kinds of Medical Equipment Capable of Producing Ionizing Radiation



(5) Number of Licenses for All Types of Medical Institution Installed with
Medical Radioactive Materials – per 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	77	9	18	1	0	47	152
New Taipei City	2	12	0	0	0	37	51
Taoyuan City	5	6	2	0	0	34	47
Hsinchu (county and city)	5	4	0	0	0	9	18
Nantou County	0	3	0	0	0	0	3
Miaoli County	15	28	2	0	15	6	66
Taichung City	0	0	0	0	2	12	14
Changhua 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	11	27
Kaohsiung City	7	7	1	0	13	21	49
Pingtung County	0	0	0	0	3	1	4
Yilan County	2	0	0	0	0	5	7
Hualien County	0	0	0	0	0	18	18
Taitung County	0	0	0	0	0	1	1
Total	136	75	23	1	33	229	497

Number of Licenses for All Types of Medical Institution Installed with Medical
Radioactive Materials



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

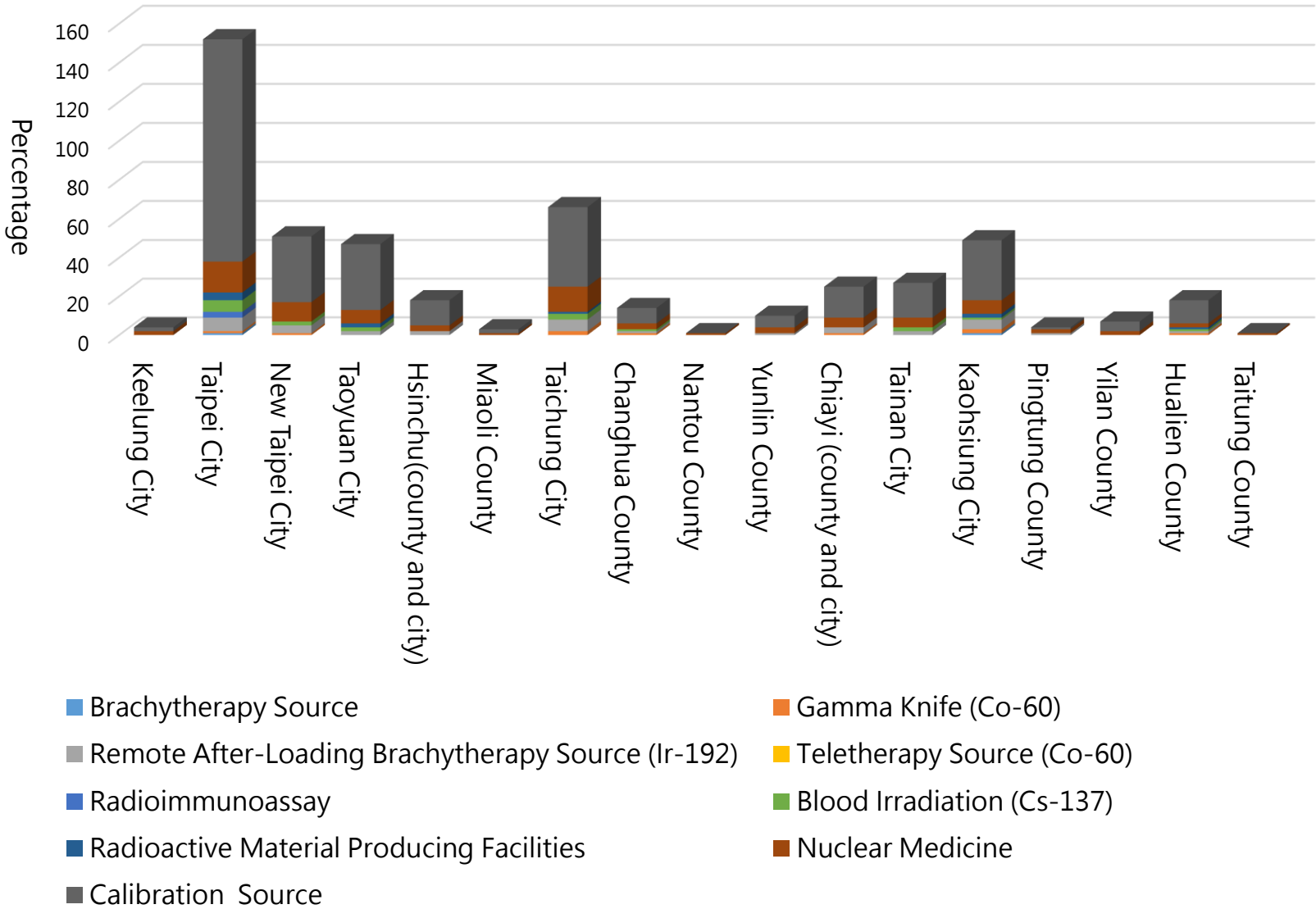
Radioactive Material County/City	Brachytherapy Source	Gamma Knife (Co-60)	Remote After- Loading Brach ytherapy Sour ce (Ir-192)	Teletherapy So urce (Co-60)	Radioimmuno assay	Blood Irradiati on (Cs-137)	Radioactive M aterial Produci ng Facilities ¹	Nuclear Medic ine ²	Calibration Source ³	Total
Keelung City	0	0	0	0	0	0	0	2	2	4
Taipei City	1	1	7	0	3	6	4	16	114	152
New Taipei City	0	1	4	0	0	2	0	10	34	51
Taoyuan City	0	0	2	0	0	2	2	7	34	47
Hsinchu(county and city)	0	0	2	0	0	0	0	3	13	18
Miaoli County	0	0	0	0	0	0	0	1	2	3
Taichung City	0	2	6	0	0	3	1	13	41	66
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	18	27
Kaohsiung City	1	2	5	0	0	1	2	7	31	49
Pingtung County	0	0	1	0	0	0	0	2	1	4
Yilan County	0	0	0	0	0	0	0	2	5	7
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	35	0	3	18	10	83	337	497
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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.

Number of Licenses for All Types of Medical Radioactive Materials



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

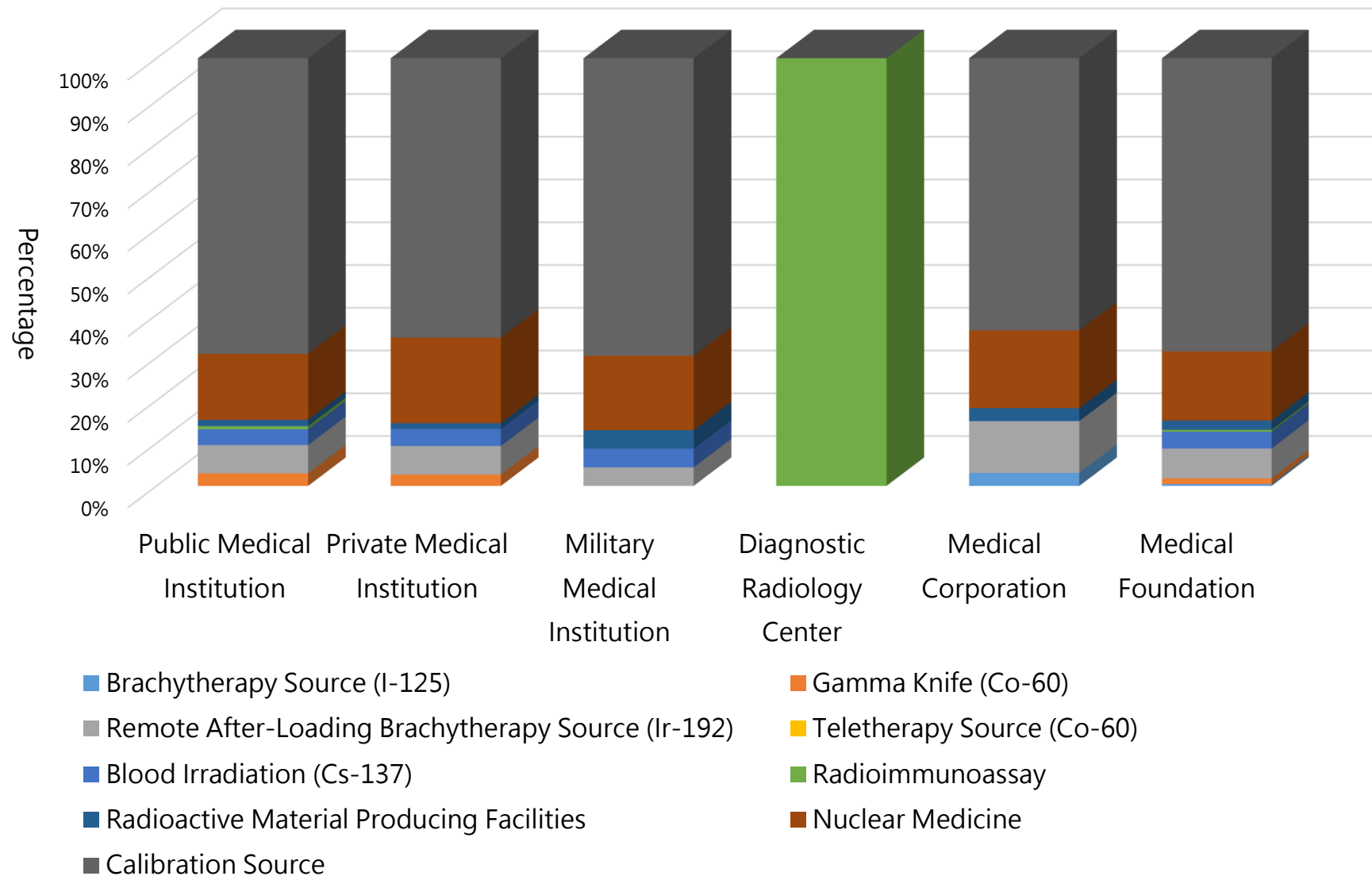
Radioactive Material Facility	Brachytherapy Source (I-125)	Gamma Knife (Co-60)	Remote After-Loading Brachytherapy Source (Ir-192)	Teletherapy Source (Co-60)	Blood Irradiation (Cs-137)	Radioimmunoassay	Radioactive Material Producing Facilities ¹	Nuclear Medicine ²	Calibration Source ³	Total
Public Medical Institution	0	4	9	0	5	1	2	21	94	136
Private Medical Institution	0	2	5	0	3	0	1	15	49	75
Military Medical Institution	0	0	1	0	1	0	1	4	16	23
Diagnostic Radiology Center	0	0	0	0	0	1	0	0	0	1
Medical Corporation	1	0	4	0	0	0	1	6	21	33
Medical Foundation	1	3	16	0	9	1	5	37	157	229
Total	2	9	35	0	18	3	10	83	337	497

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.

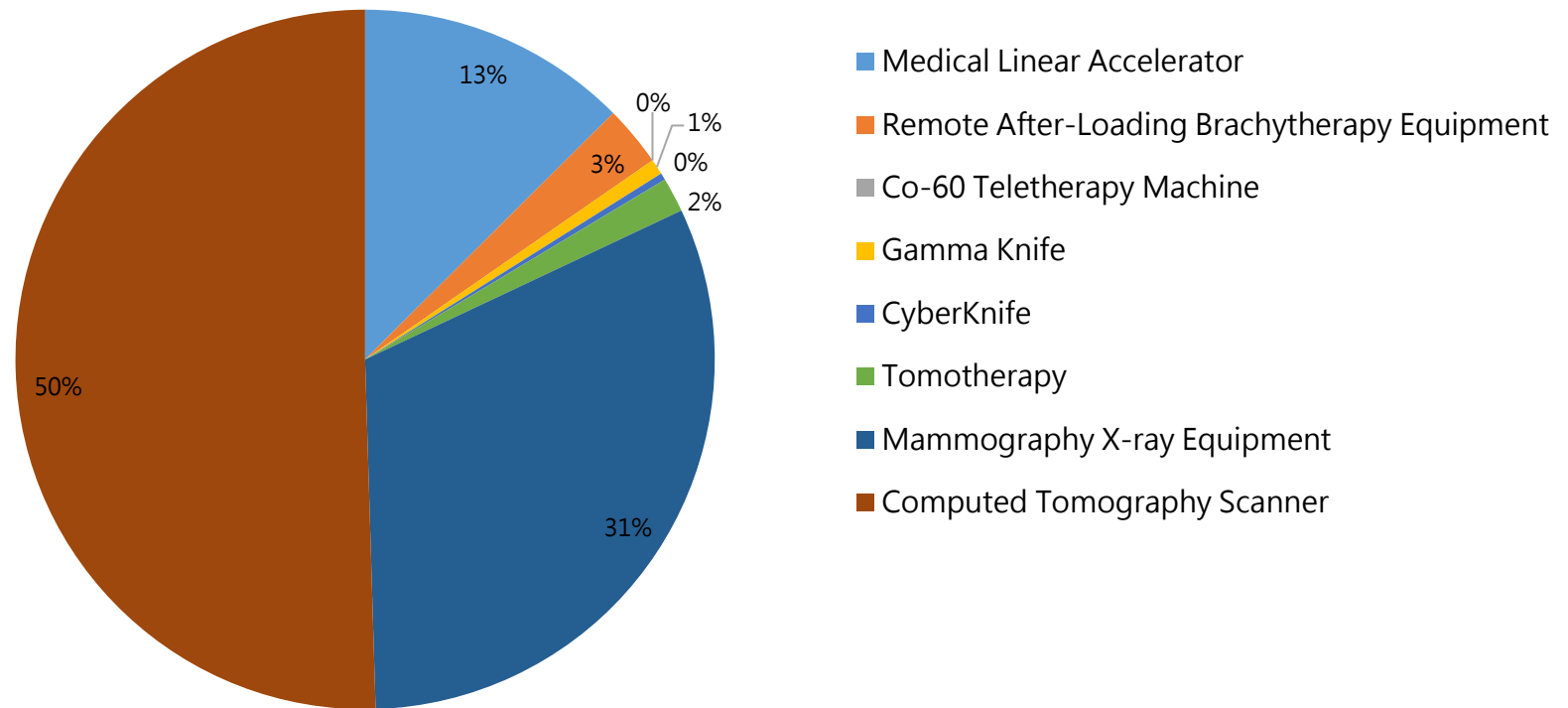
Statistics of the Number of Licenses for All Types of Medical Institution Installed with All Types of Medical Radioactive Materials



(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	157
Remote After-Loading Brachytherapy Equipment	35
Co-60 Teletherapy Machine	0
Gamma Knife	9
CyberKnife	4
Tomotherapy	20
Mammography X-ray Equipment (not include disabled equipment)	394
Computed Tomography Scanner (not include disabled equipment)	631
Total	1,250

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

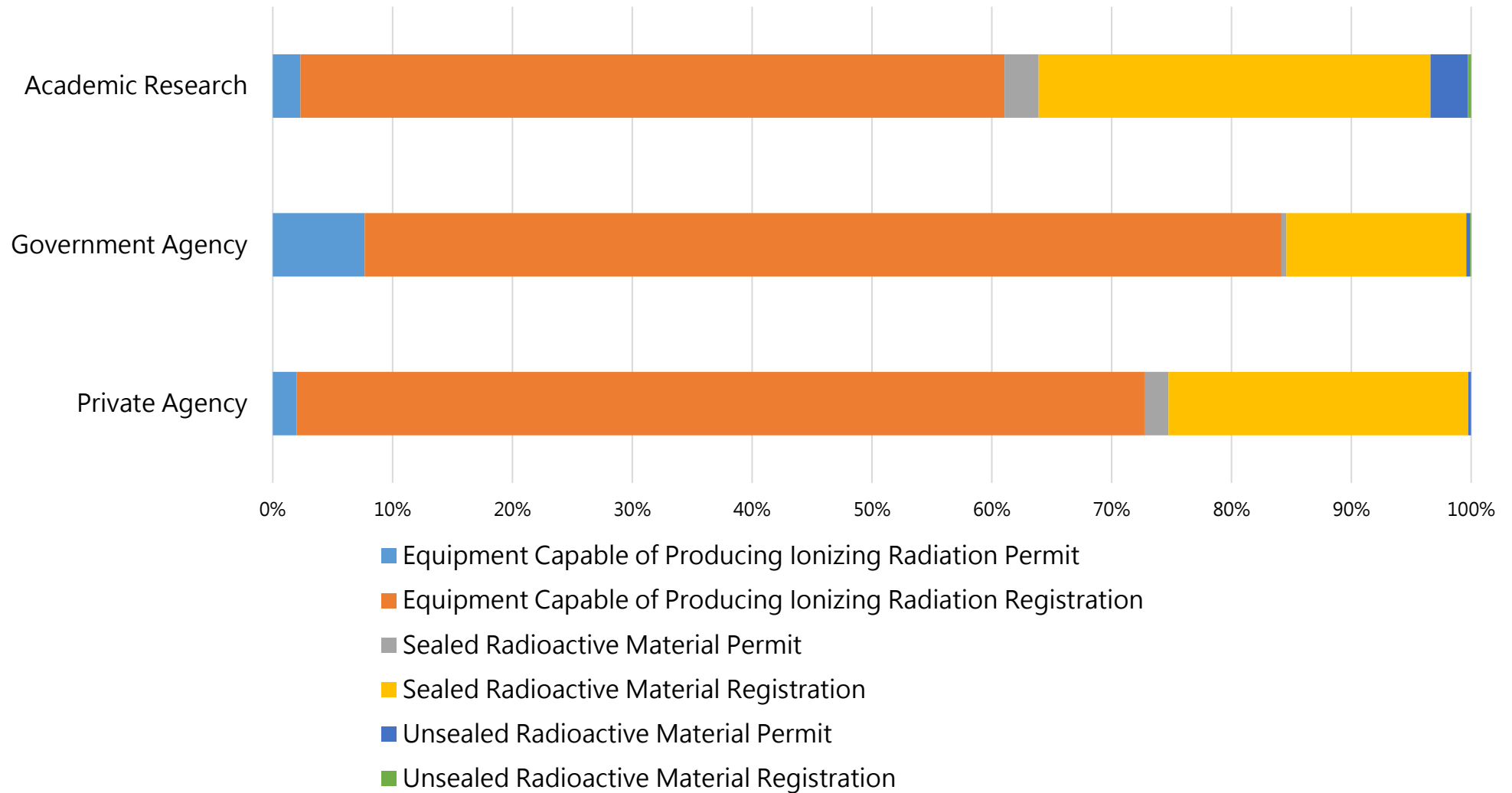


2. Non-Medical Use

(1) Number of Licenses for All Types of Facilities Installed with Non-medical Radiation Sources – per type

Type Facility	Equipment Capable of Producing Ionizing Radiation		Sealed Radioactive Material		Unsealed Radioactive Material		Total
	Permit	Registration	Permit	Registration	Permit	Registration	
Private Agency	223	7,871	223	2,782	24	3	11,126
Government Agency	77	769	4	151	3	1	1,005
Academic Research	17	433	21	241	23	2	737
Total	317	9,073	248	3,174	50	6	12,868

Number of Licenses for All Types of Facilities Installed with Non-medical Radiation Sources



(2) Number of Licenses for All Types of Facilities Installed with Non-medical Radiation Sources – per 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	Unseal ed	Equipm ent	Sealed	Unseal ed	Equipm ent	Sealed	Unseal ed	Equipm ent	Sealed	Unseal ed	Equipm ent	Sealed	Unseal ed
Keelung City	2	3	0	3	0	0	0	0	0	43	1		23	2	0	4	4	0
Taipei City	24	5	2	13	2	1	2	1	4	539	85	0	142	57	1	71	42	1
New Taipei City	9	5	10	7	1	1	0	0	0	1,188	216	1	22	15	0	7	1	0
Taoyuan City	37	16	2	18	0	0	7	15	8	1,709	497	1	291	28	0	55	63	0
Hsinchu(county and city)	8	6	2	1	0	0	6	4	4	827	364	0	7	2	0	98	35	0
Miaoli County	5	6	1	0	0	0	0	0	0	190	110	0	3	0	0	2	0	0
Taichung City	21	10	4	7	0	0	0	0	3	751	268	0	38	16	0	59	29	0
Changhua County	5	5	0	0	0	0	0	0	0	222	103	0	4	0	0	6	3	0
Nantou County	2	2	0	2	0	0	0	0	0	68	17	0	4	2	0	3	0	0
Yunlin County	6	32	0	0	0	0	2	0	0	147	202	0	3	0	0	7	4	0
Chiayi (county and city)	3	0	0	3	0	0	0	0	1	92	28	0	10	3	0	8	3	1
Tainan City	13	1	0	5	0	0	0	0	1	683	404	0	32	4	0	48	18	0
Kaohsiung City	78	127	2	8	1	1	0	1	1	1,226	352	0	102	13	0	34	19	0
Pingtung County	8	2	1	4	0	0	0	0	0	91	38	1	8	4	0	8	10	0
Yilan County	2	3	0	0	0	0	0	0	0	65	61	0	2	1	0	3	0	0
Hualien County	0	0	0	3	0	0	0	0	1	20	26	0	15	1	0	20	9	0

Taitung County	0	0	0	2	0	0	0	0	0	8	9	0	17	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	0	0	0	8	0	0	0	0	0
Lienchiang County	0	0	0	0	0	0	0	0	0	1	0	0	14	0	0	0	0	0
Total	223	223	24	77	4	3	17	21	23	7,871	2,782	3	769	151	1	433	241	2

Remarks:

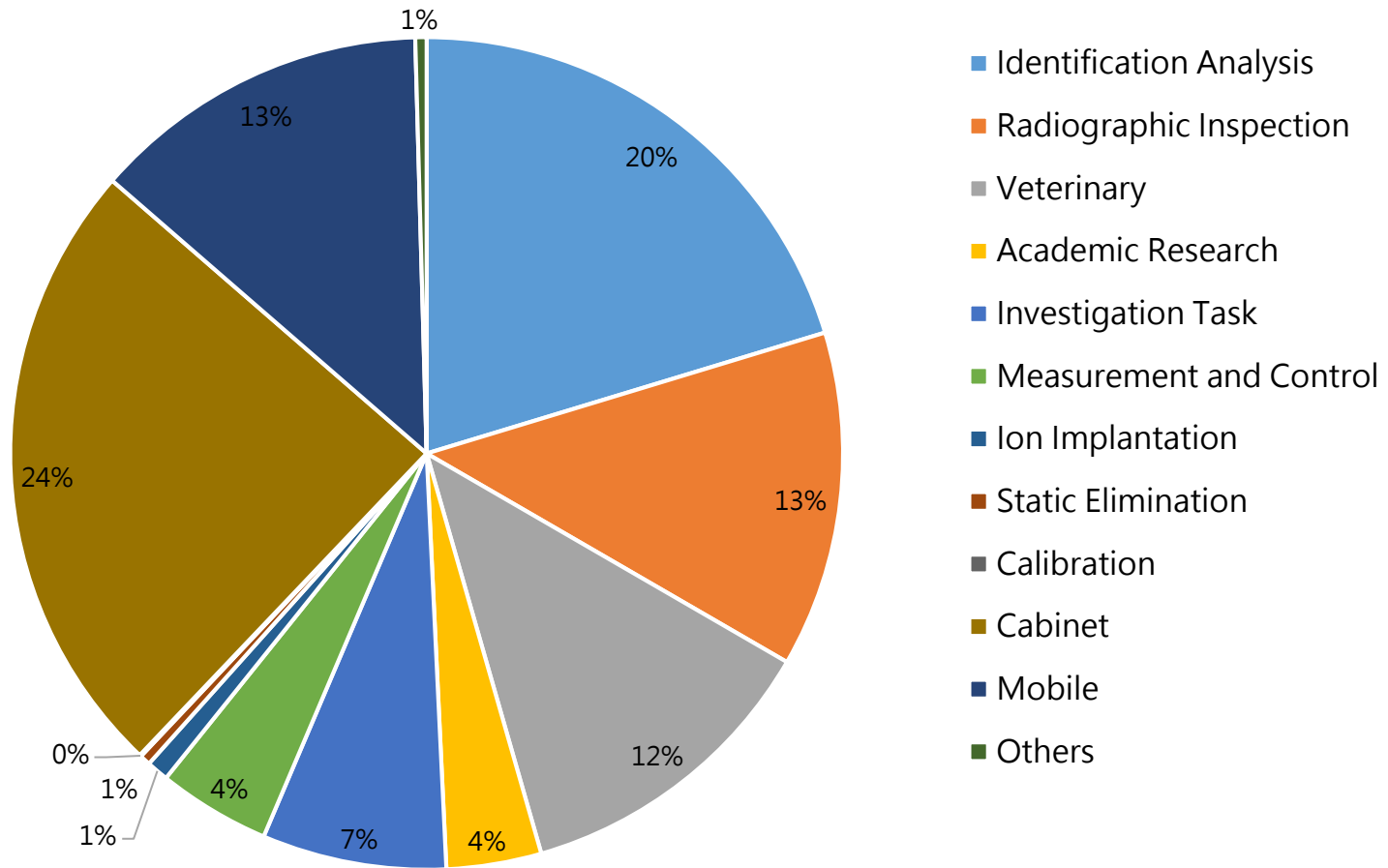
1. Equipment: Equipment capable of producing ionizing radiation.
2. Sealed: Sealed radioactive material.
3. Unsealed: Unsealed radioactive material.

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

Equipment Usage	Number of Licenses
Identification Analysis	1,907
Radiographic Inspection	1,225
Veterinary	1,146
Academic Research	346
Investigation Task	672
Measurement and Control	410
Ion Implantation	80
Static Elimination	39
Calibration	6
Cabinet	2,280
Mobile	1,238
Others ^{Remarks}	41
Total	9,390

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

Number of Licenses for Non-medical Equipment Capable of Producing Ionizing Radiation for Various Purposes



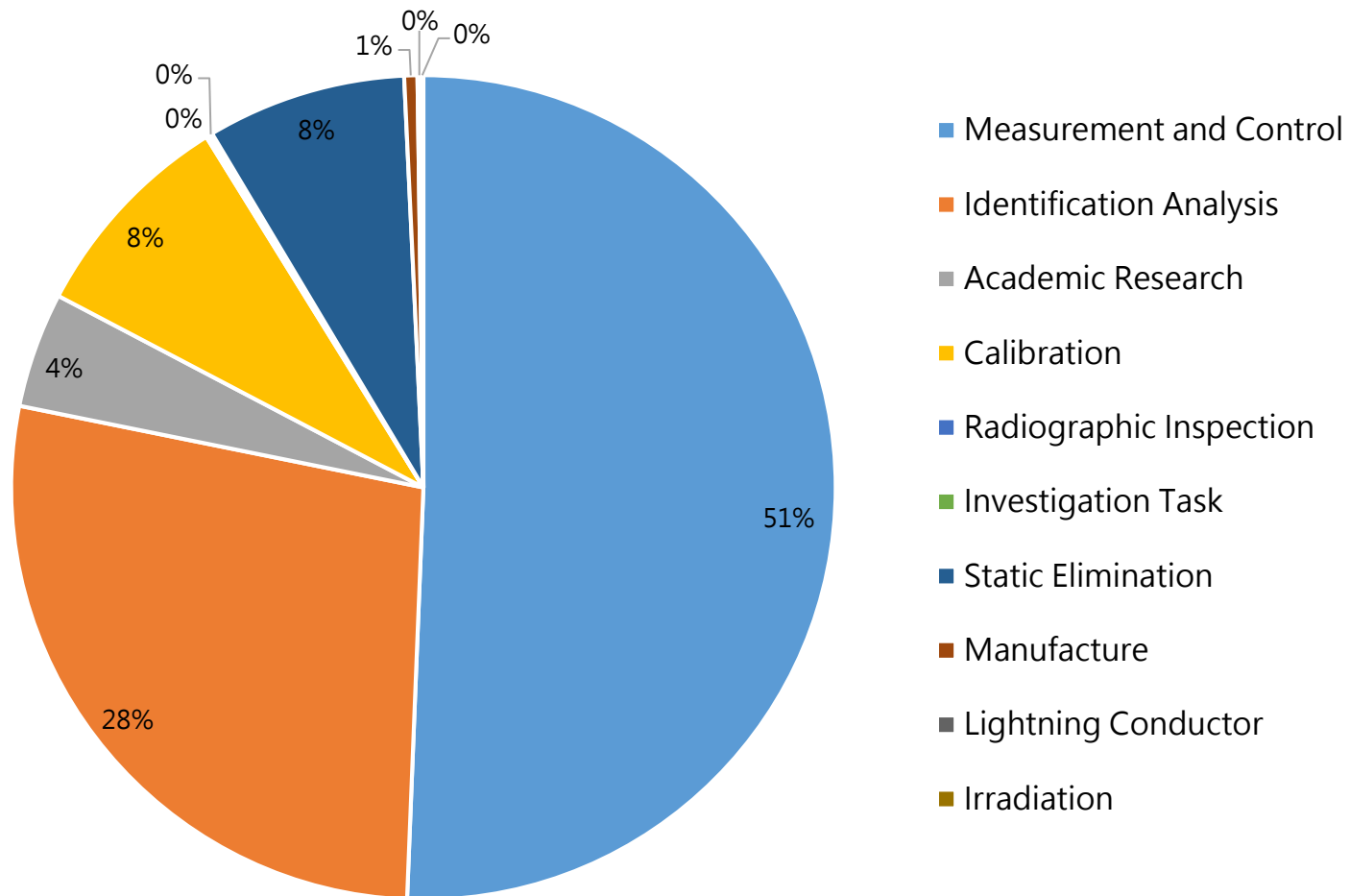
(4) Number of Licenses for Non-medical Radioactive Materials for Various Purposes

Radioactive Material Usage	Number of Licenses
Measurement and Control	1,761
Identification Analysis	958
Academic Research	157
Calibration	295
Radiographic Inspection	5
Investigation Task	4
Static Elimination	272
Manufacture ¹	18
Lightning Conductor ²	5
Irradiation ³	3
Total	3,478

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.

Number of Licenses for Non-medical Radioactive Materials for Various Purposes



3. Personnel Dose

(1) Statistics of the Number of Radiation Workers Nationwide

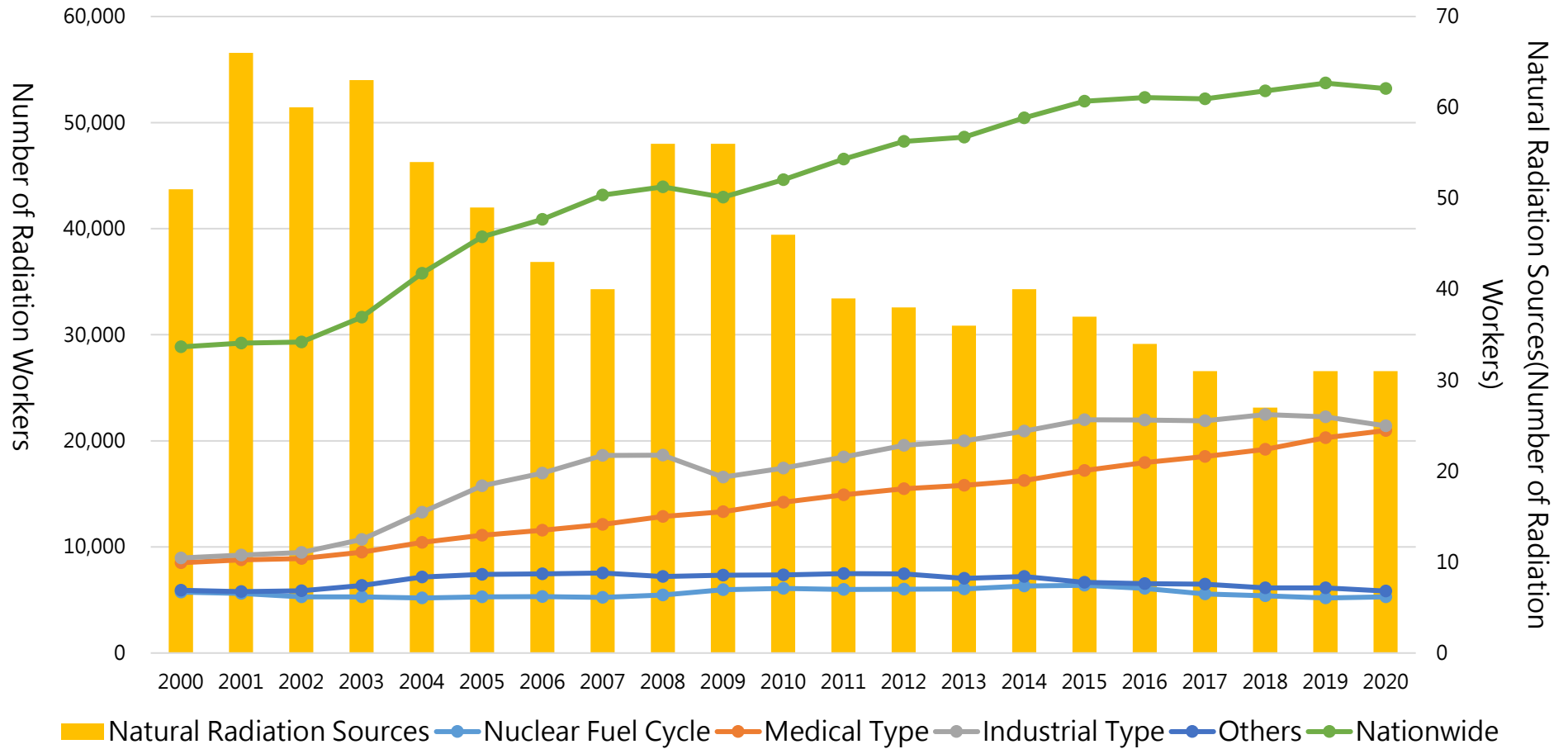
Year	Nuclear Fuel Cycle	Medical Type	Industrial Type	Natural Radiation Sources ¹	Others ²	Nationwid e ³
2000	5,731	8,510	8,960	51	5,925	28,856
2001	5,622	8,775	9,221	66	5,786	29,223
2002	5,296	8,914	9,468	60	5,857	29,325
2003	5,281	9,504	10,702	63	6,361	31,649
2004	5,189	10,425	13,272	54	7,167	35,782
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

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

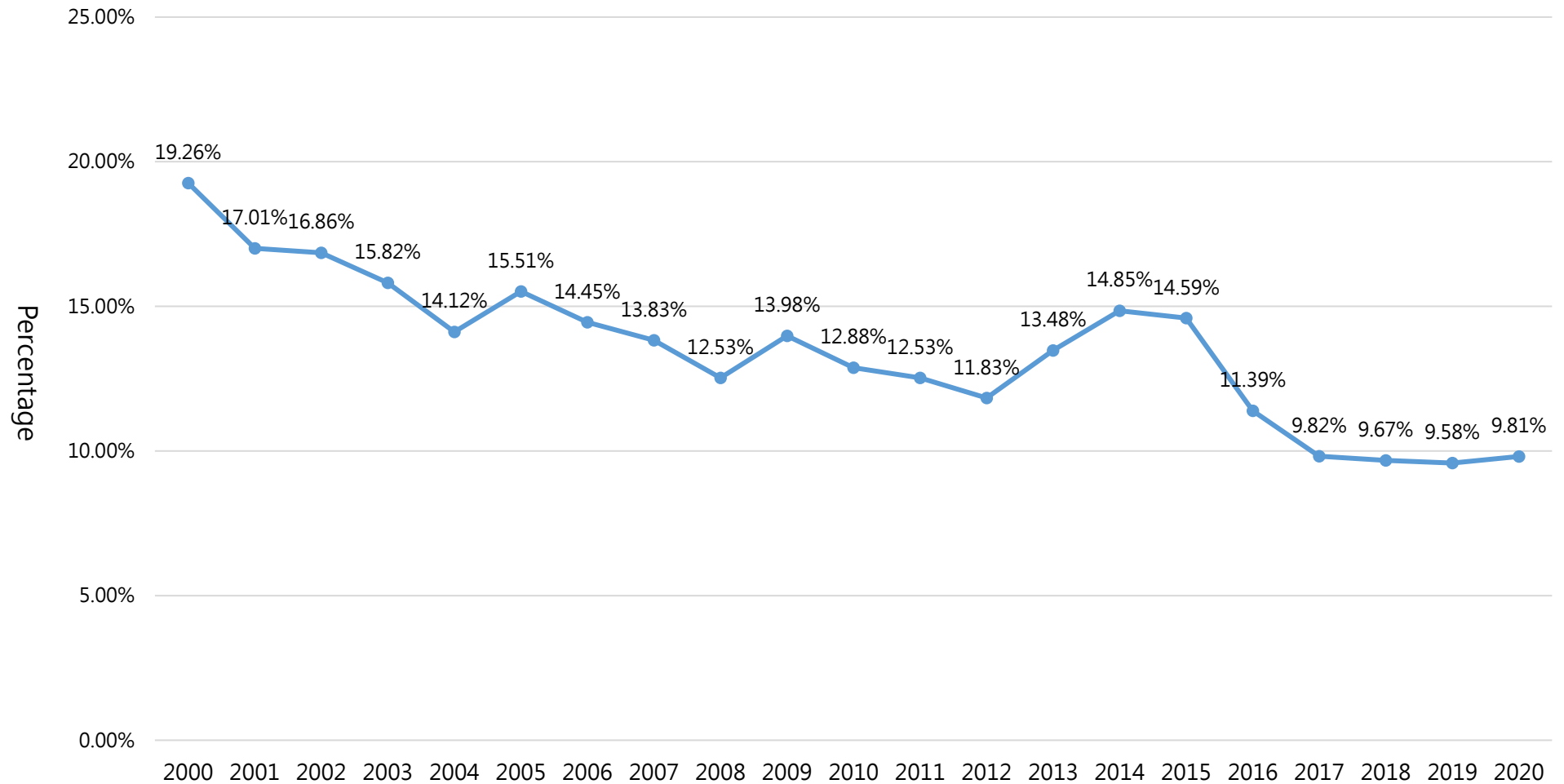


(2) Statistics of the Number of Radiation Workers with Dose Value and Total Number of Personnel Tested
Nationwide

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	19.26%	17.01%	16.86%	15.82%	14.12%	15.51%	14.45%	13.83%	12.53%	13.98%	12.88%	12.53%	11.83%	13.47%

Year	2014	2015	2016	2017	2018	2019	2020
Number of People with Dose Value	7,492	7,589	5,966	5,132	5,127	5,148	5,220
Total Number of Personnel Tested	50,438	52,012	52,369	52,248	52,995	53,723	53,220
Percentage	14.85%	14.59%	11.39%	9.82%	9.67%	9.58%	9.81%

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



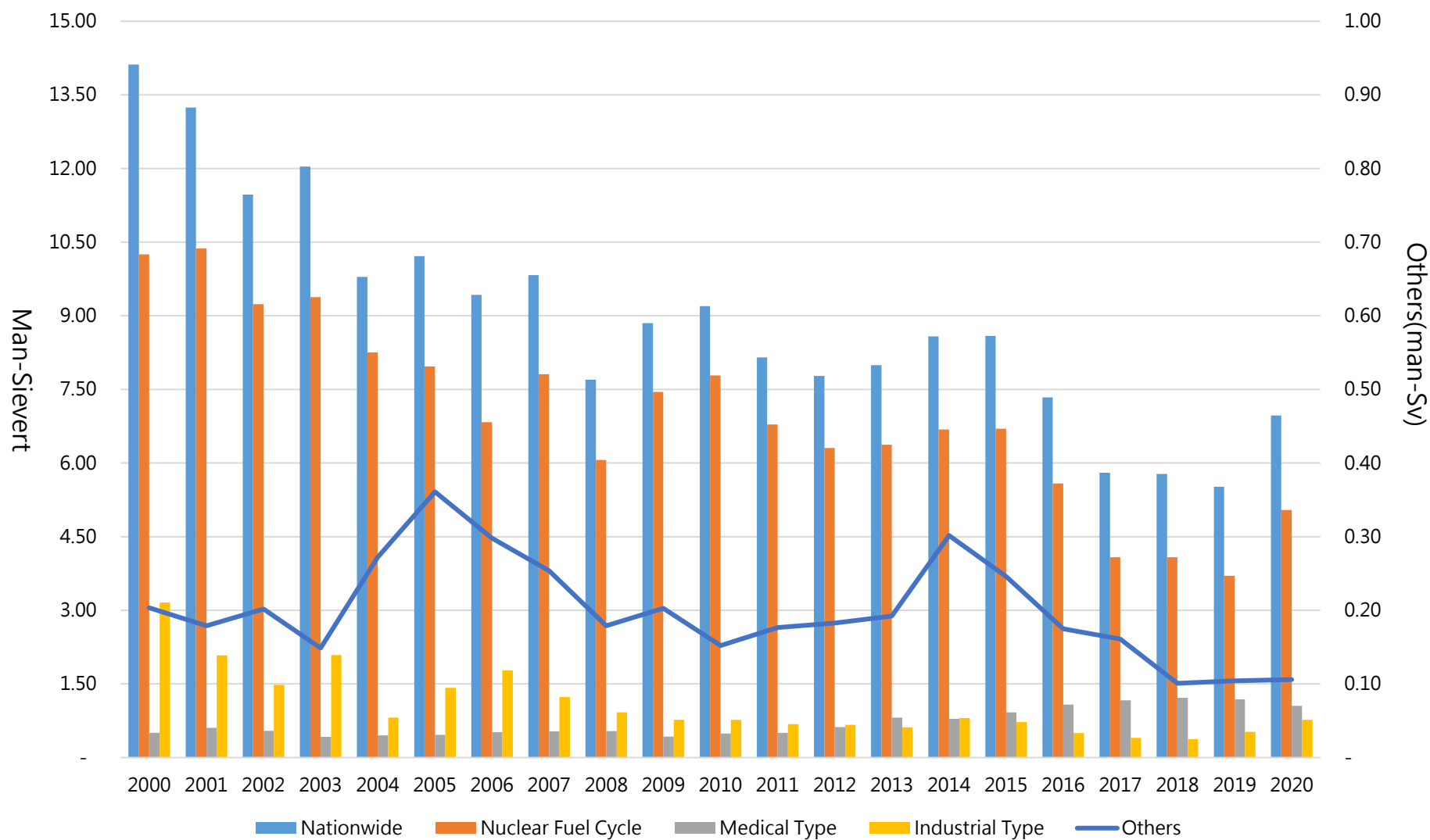
(3) Statistics of Total Collective Dose for Radiation Workers Nationwide

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
Nationwide	7.34	5.80	5.78	5.52	6.97
Nuclear Fuel Cycle (Nuclear Power Plant)	5.59	4.08	4.08	3.70	5.05
Medical Type	1.08	1.16	1.21	1.19	1.05
Industrial Type (Non-Medical)	0.51	0.40	0.38	0.52	0.77
Others (Research)	0.17	0.16	0.10	0.10	0.11
Natural Radiation Sources	0.00	0.00	0.00	0.00	0.00

Unit : Man-Sievert (man-Sv)

Statistics of Total Collective Dose for Radiation Workers Nationwide



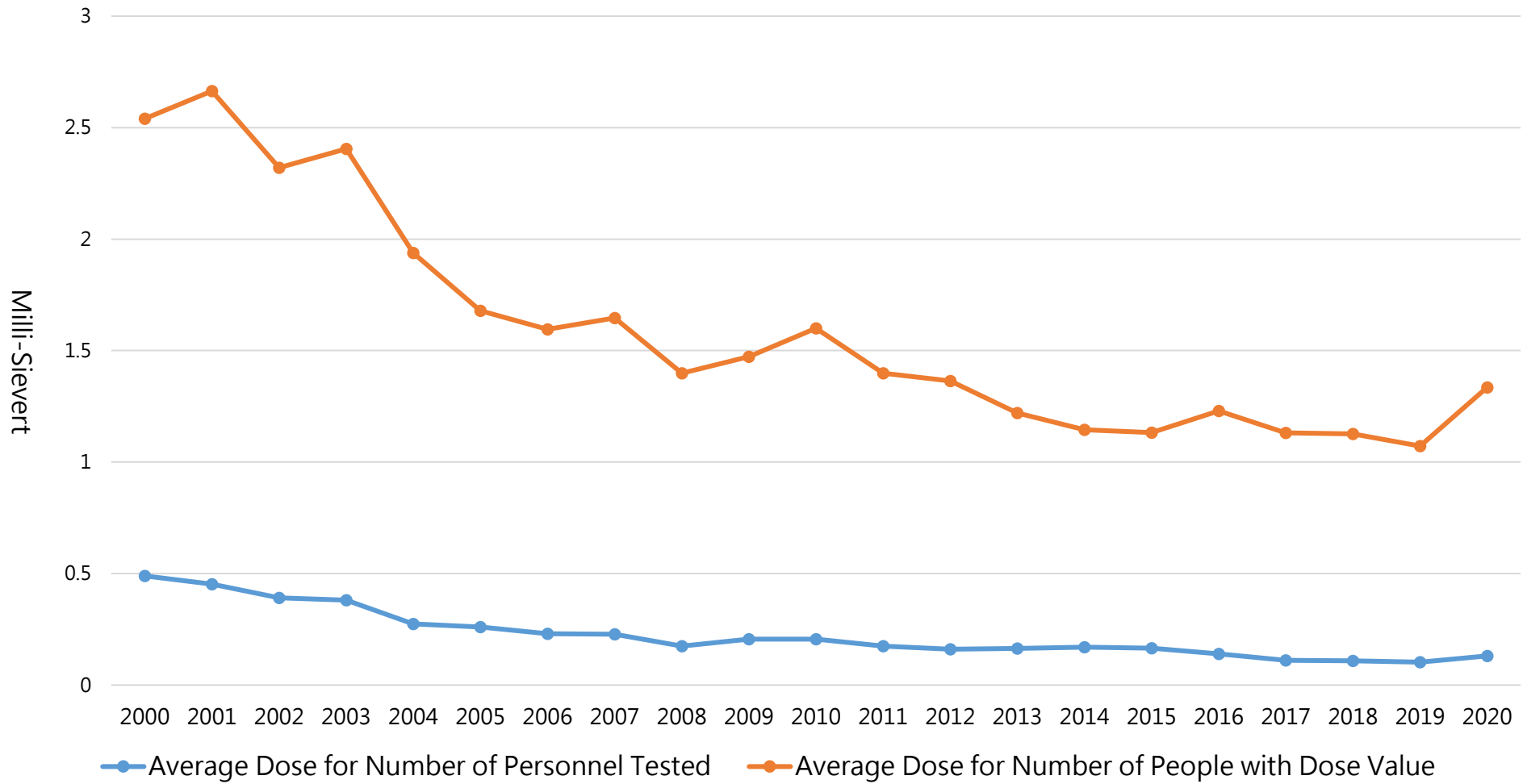
(4) Statistics of Annual Average Dose for Radiation Workers Nationwide

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
Average Dose for Number of Personnel Tested	0.14	0.11	0.11	0.10	0.13
Average Dose for Number of People with Dose Value	1.23	1.13	1.13	1.07	1.34

Unit : Milli-Sievert (mSv)

Statistics of Annual Average Dose for Radiation Workers Nationwide

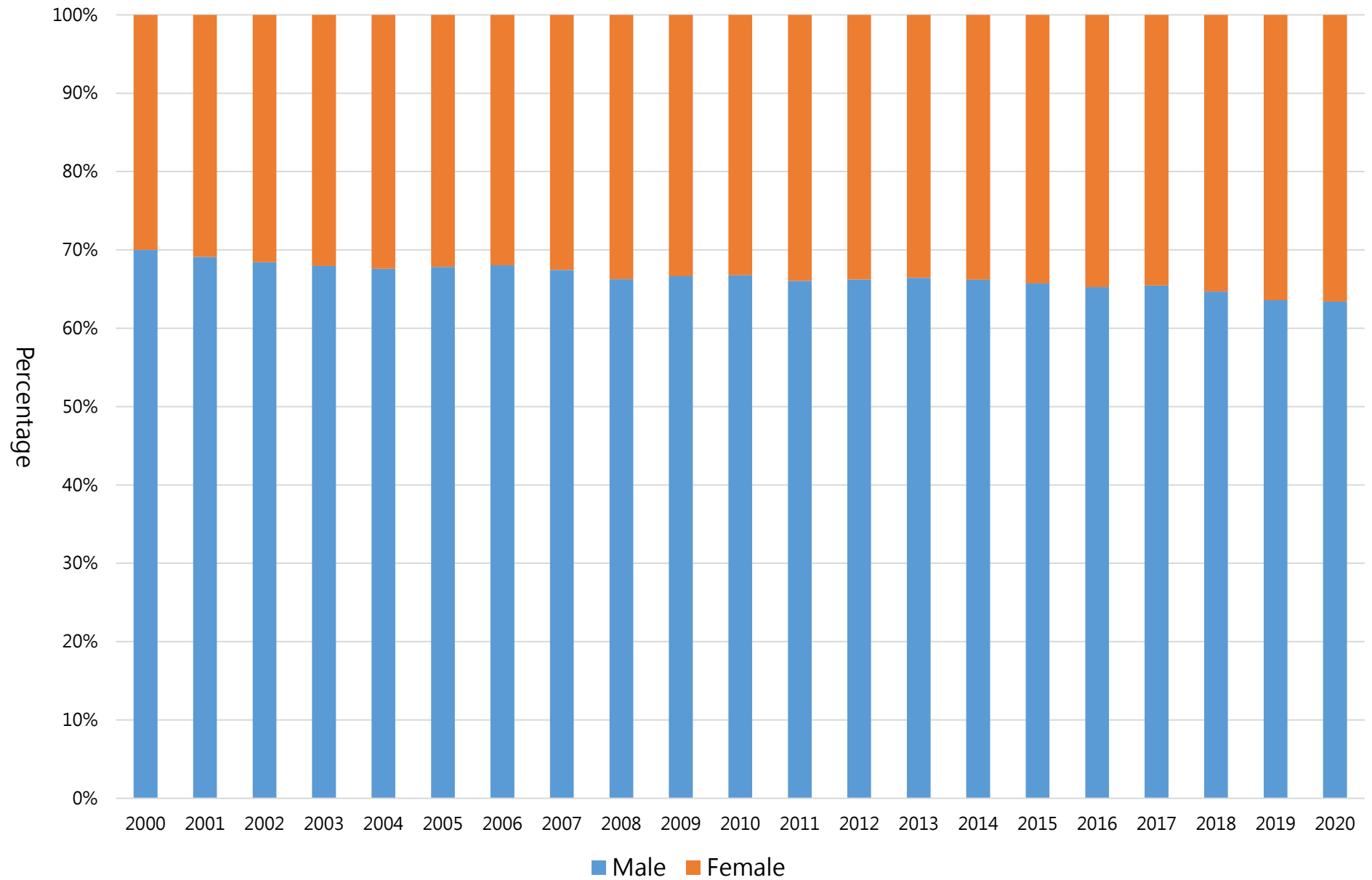


(5) Statistics of Gender for Radiation Workers Nationwide

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

Year	2014	2015	2016	2017	2018	2019	2020
Male	33,397	34,190	34,178	34,210	34,283	34,163	33,750
Female	17,040	17,822	18,191	18,038	18,712	19,560	19,470
Total	50,437	52,012	52,369	52,248	52,995	53,723	53,220

Statistics of Gender for Radiation Workers Nationwide



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

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

LLD : Lower limit of detection

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

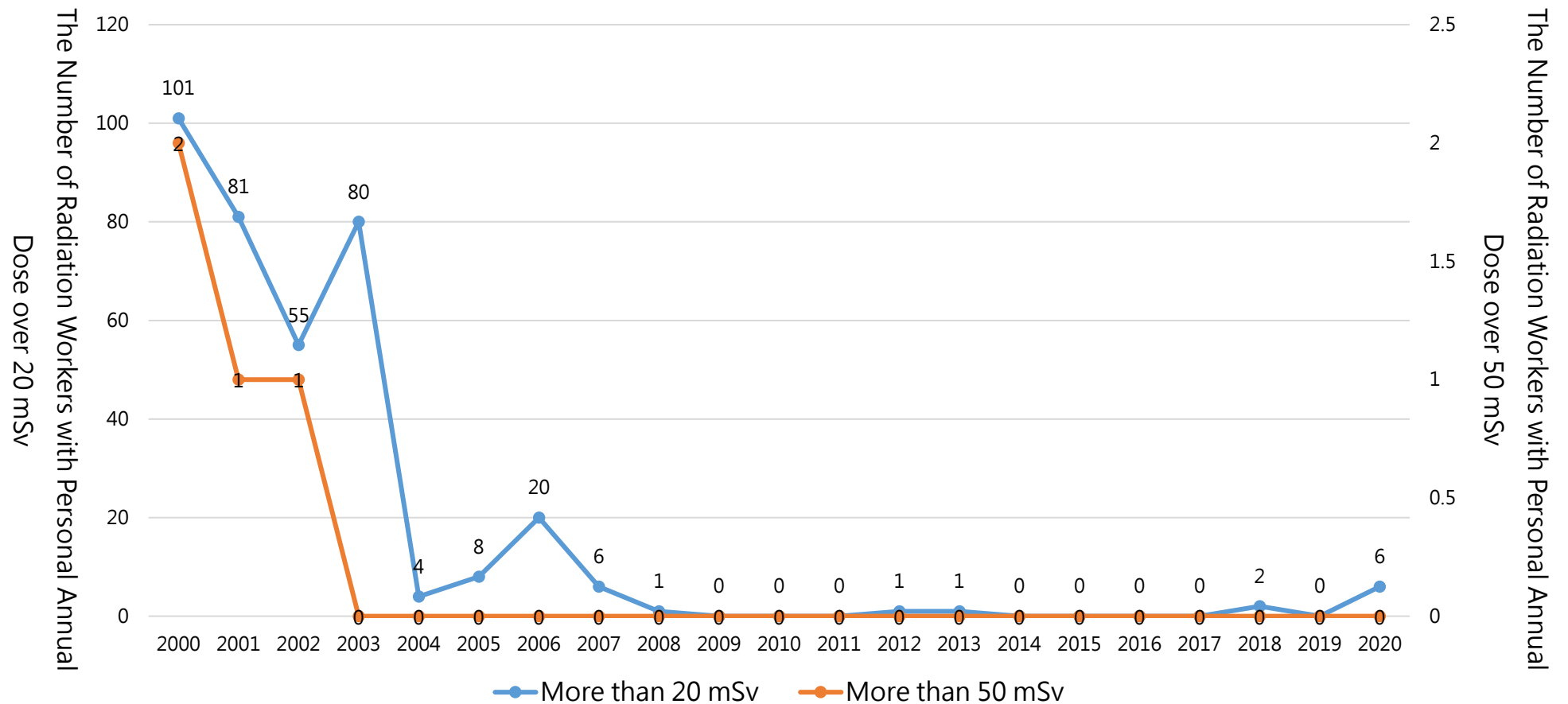
Dose Interval (mSv)	≤LLD	≤ 1	1-2.5	2.5-5	5-7.5	7.5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-100	> 100	Percentage of People with Dose Value
2000	80.74	11.42	3.09	1.90	0.94	0.66	0.59	0.31	0.16	0.09	0.05	0.03	0.01	0.00	0.01	0.00	19.26%
2001	82.99	9.49	3.05	1.84	0.86	0.55	0.64	0.29	0.12	0.08	0.06	0.00	0.01	0.00	0.00	0.00	17.01%
2002	83.14	9.91	2.92	1.77	0.77	0.50	0.53	0.26	0.14	0.03	0.02	0.00	0.00	0.00	0.00	0.00	16.86%
2003	84.18	9.48	2.53	1.64	0.72	0.50	0.43	0.27	0.14	0.07	0.02	0.02	0.01	0.00	0.00	0.00	15.82%
2004	85.88	8.81	2.30	1.43	0.55	0.35	0.46	0.21	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	14.12%
2005	84.49	10.24	2.38	1.35	0.62	0.36	0.41	0.13	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	15.51%
2006	85.55	9.76	2.09	1.29	0.52	0.34	0.32	0.08	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	14.45%
2007	86.17	9.09	2.11	1.36	0.51	0.29	0.36	0.10	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.83%
2008	87.47	8.29	2.16	1.14	0.42	0.27	0.22	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.53%
2009	86.02	9.24	2.19	1.38	0.59	0.34	0.23	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.98%
2010	87.12	8.19	2.15	1.38	0.53	0.31	0.27	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.88%
2011	87.47	8.34	2.10	1.09	0.51	0.29	0.17	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.53%
2012	88.17	7.79	2.14	1.10	0.42	0.21	0.14	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.83%
2013	86.52	9.46	2.07	1.14	0.40	0.19	0.16	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.48%
2014	85.15	10.77	2.13	1.07	0.49	0.20	0.17	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.85%
2015	85.41	10.41	2.28	1.09	0.42	0.21	0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.59%
2016	88.61	8.02	1.81	0.91	0.30	0.17	0.15	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.39%
2017	90.18	7.11	1.45	0.75	0.26	0.14	0.10	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.82%
2018	90.33	6.94	1.59	0.68	0.22	0.11	0.10	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.67%
2019	90.42	6.91	1.53	0.68	0.26	0.11	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.58%
2020	90.19	6.89	1.52	0.75	0.23	0.15	0.20	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.81%

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
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
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

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

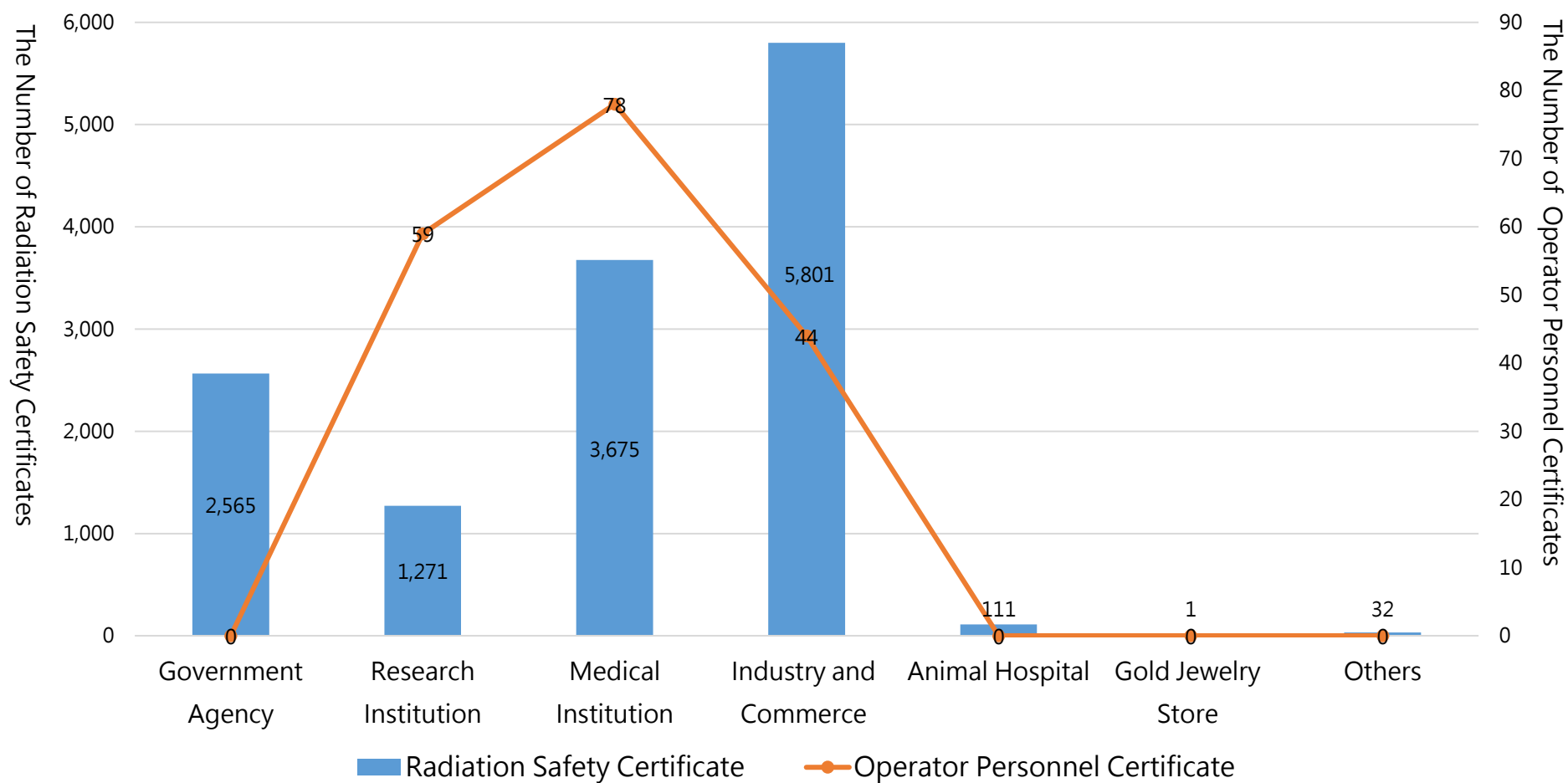


4. Radiation Protection Personnel, Radiation Safety Certificates and Radiation Protection Business

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

Certificate Type \ Facility	Government Agency	Research Institution	Medical Institution	Industry and Commerce	Animal Hospital	Gold Jewelry Store	Others (Including unemployed people)	Total
Radiation Safety Certificate	2,565	1,271	3,675	5,801	111	1	32	13,456
Operator Personnel Certificate	0	59	78	44	0	0	0	181
Total	2,565	1,330	3,753	5,845	111	1	32	13,637

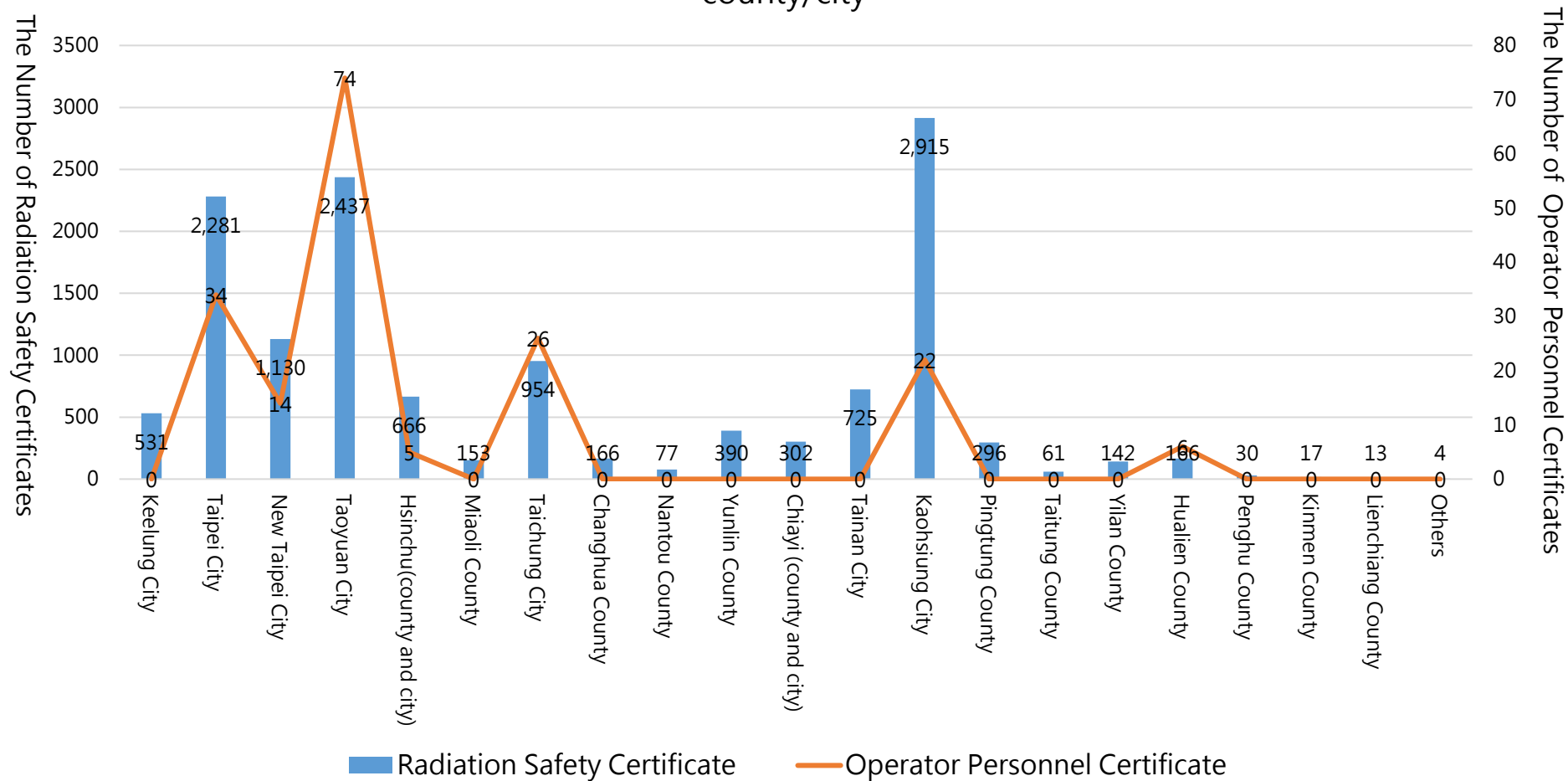
Total Number of Radiation Safety Certificates and Operator Personnel Certificates – per facility



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

Certificate type County/City	Radiation Safety Certificate	Operator Personnel Certificate	Total
Keelung City	531	0	531
Taipei City	2,281	34	2,315
New Taipei City	1,130	14	1,144
Taoyuan City	2,437	74	2,511
Hsinchu(county and city)	666	5	671
Miaoli County	153	0	153
Taichung City	954	26	980
Changhua County	166	0	166
Nantou County	77	0	77
Yunlin County	390	0	390
Chiayi (county and city)	302	0	302
Tainan City	725	0	725
Kaohsiung City	2,915	22	2,937
Pingtung County	296	0	296
Taitung County	61	0	61
Yilan County	142	0	142
Hualien County	166	6	172
Penghu County	30	0	30
Kinmen County	17	0	17
Lienchiang County	13	0	13
Others	4	0	4
Total	13,456	181	13,637

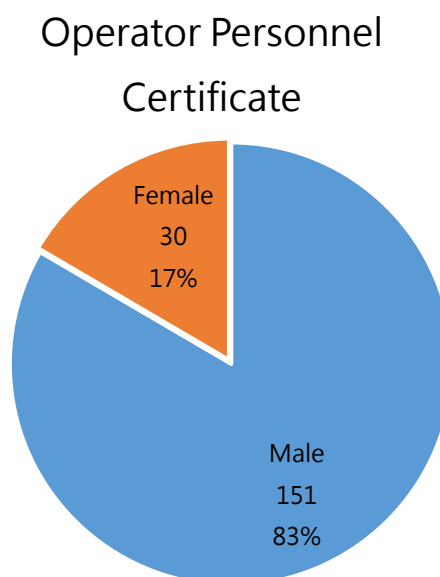
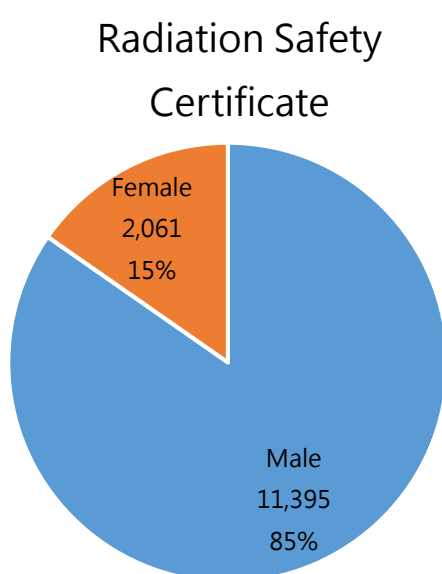
Total Number of Radiation Safety Certificates and Operator Personnel Certificates – per county/city



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

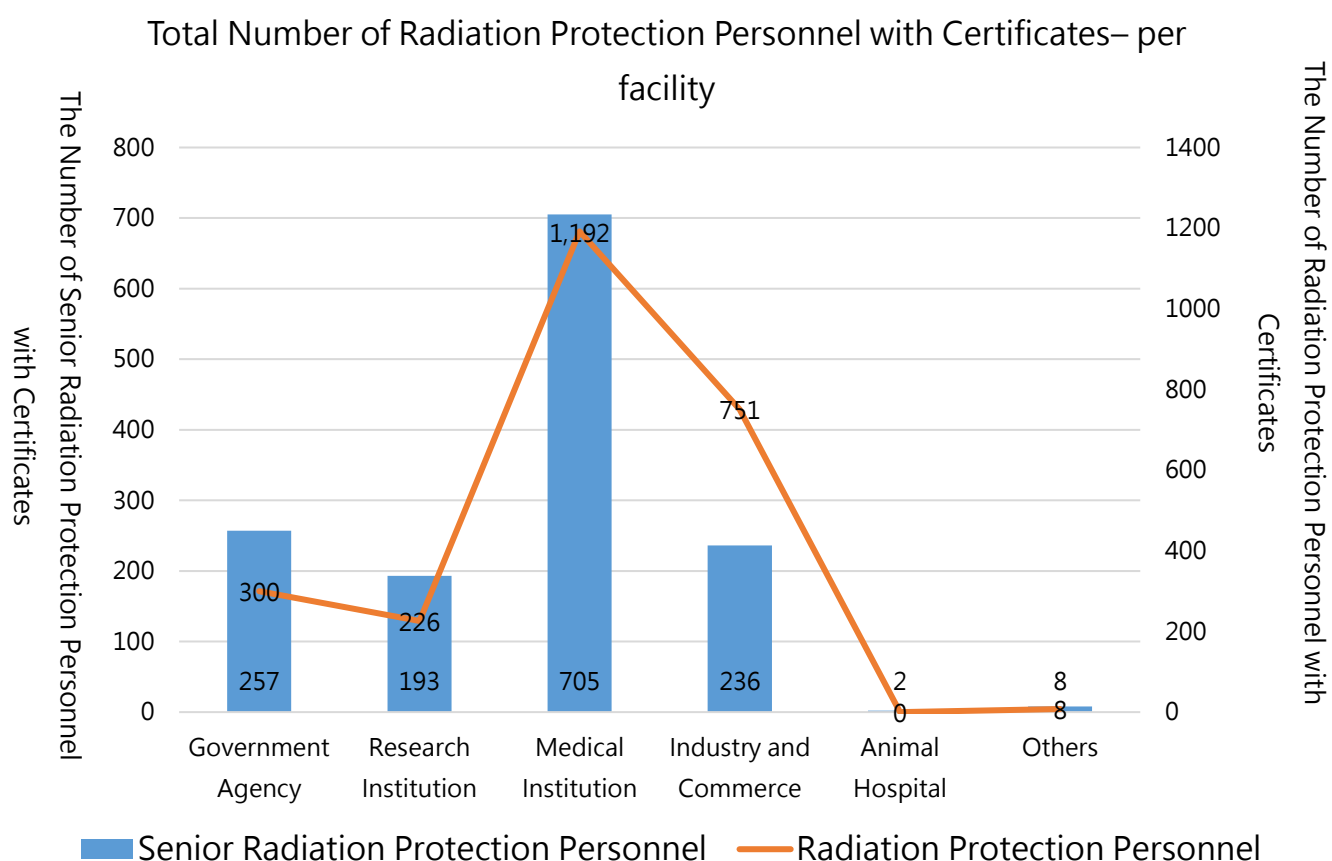
Certificate Type \ Gender	Male	Female	Total
Radiation Safety Certificate	11,395	2,061	13,456
Operator Personnel Certificate	151	30	181
Total	11,546	2,091	13,637

Total Number of Radiation Safety Certificates and Operator Personnel
Certificates – per gender



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

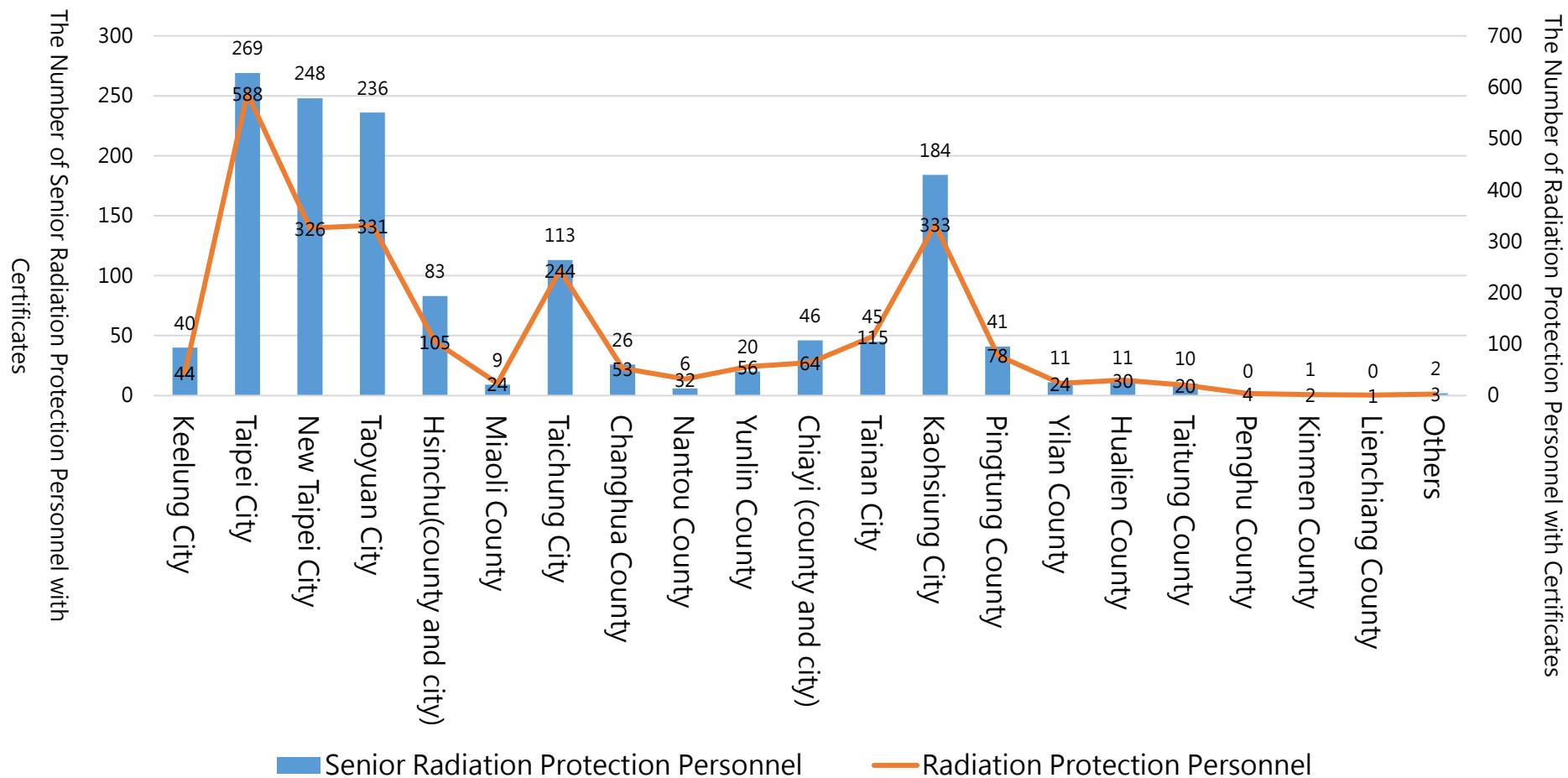
Certificate Type \ Facility	Government Agency	Research Institution	Medical Institution	Industry and Commerce	Animal Hospital	Others (Including unemployed people)	Total
Senior Radiation Protection Personnel	257	193	705	236	2	8	1,401
Radiation Protection Personnel	300	226	1,192	751	0	8	2,477
Total	557	419	1,897	987	2	16	3,878



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

Certificate Type County/City	Senior Radiation Protection Personnel	Radiation Protection Personnel	Total
Keelung City	40	44	84
Taipei City	269	588	857
New Taipei City	248	326	574
Taoyuan City	236	331	567
Hsinchu(county and city)	83	105	188
Miaoli County	9	24	33
Taichung City	113	244	357
Changhua County	26	53	79
Nantou County	6	32	38
Yunlin County	20	56	76
Chiayi (county and city)	46	64	110
Tainan City	45	115	160
Kaohsiung City	184	333	517
Pingtung County	41	78	119
Yilan County	11	24	35
Hualien County	11	30	41
Taitung County	10	20	30
Penghu County	0	4	4
Kinmen County	1	2	3
Lienchiang County	0	1	1
Others	2	3	5
Total	1,401	2,477	3,878

Total Number of Radiation Protection Personnel with Certificates – per county/city

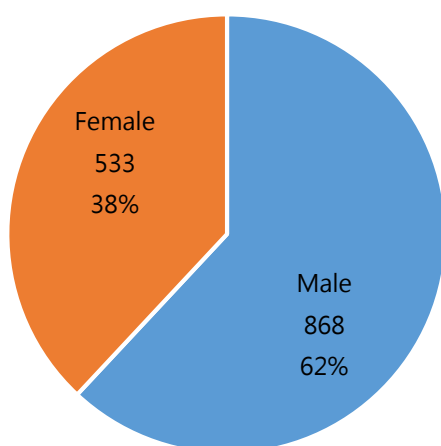


(6) Total Number of Radiation Protection Personnel with Certificates – per gender

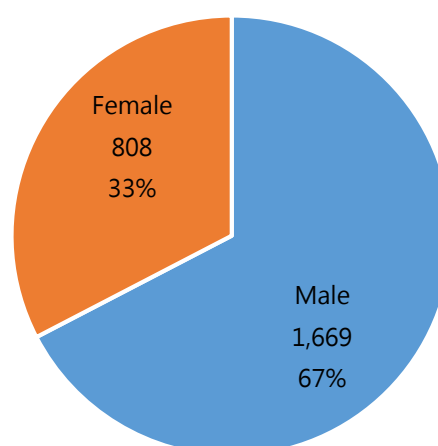
Certificate Type \ Gender	Gender		
	Male	Female	Total
Senior Radiation Protection Personnel	868	533	1,401
Radiation Protection Personnel	1,669	808	2,477
Total	2,537	1,341	3,878

Total Number of Radiation Protection Personnel with Certificates – per gender

Senior Radiation Protection Personnel



Radiation Protection Personnel

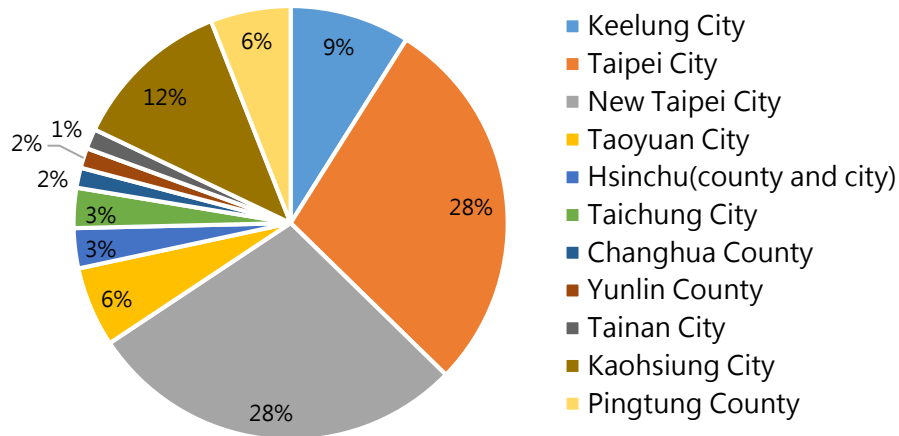


(7) Total Number of Radiation Protection Business with Certificates– per business category and county/city

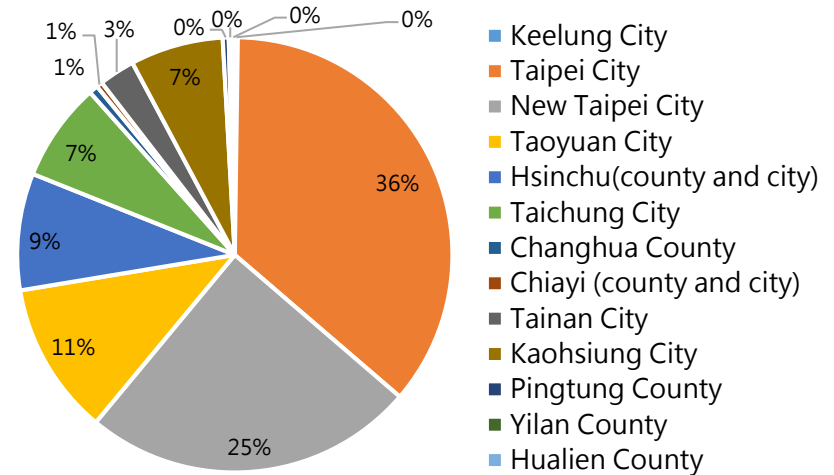
Business category County/City	Radiation Protection Detection Businesses	Radiation Protection Service Businesses	Institutions of Radiation Protection Training Affairs	Total
Keelung City	6	1	1	8
Taipei City	19	162	1	182
New Taipei City	19	111	5	135
Taoyuan City	4	51	3	58
Hsinchu(county and city)	2	39	5	46
Miaoli County	0	0	0	0
Taichung City	2	33	2	37
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	12	2	15
Kaohsiung City	8	31	2	41
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	67	449	23	539

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

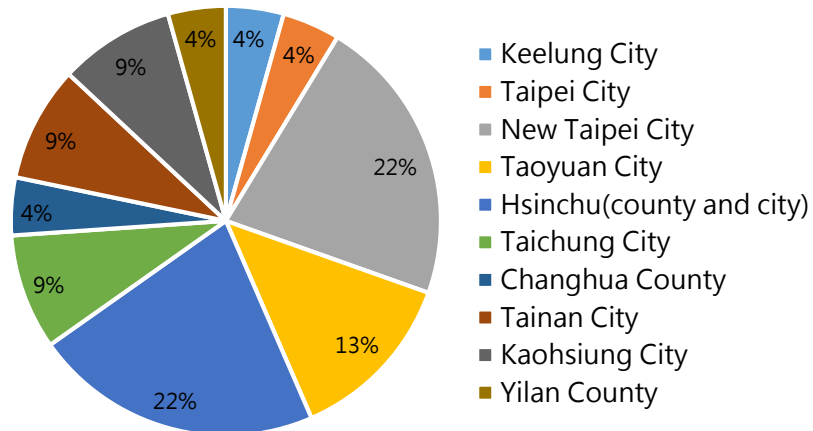
Radiation Protection Detection Businesses



Radiation Protection Service Businesses



Institutions of Radiation Protection Training Affairs



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

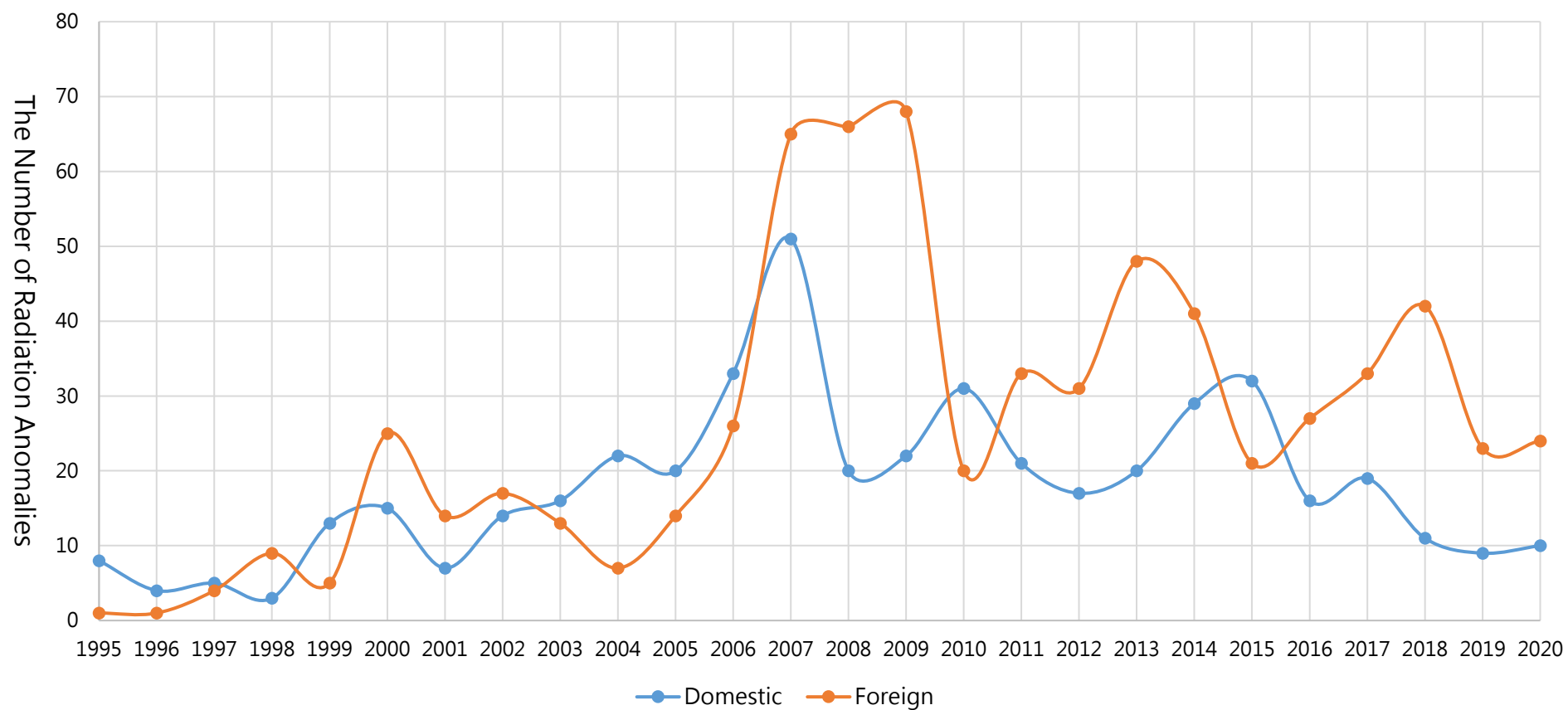
(1) Statistics of the Number of Radiation Anomalies Found in the Steel Plants over the Years

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	Total
Domestic	19	11	9	10	468
Foreign	33	42	23	24	678
Total	52	53	32	34	1,146

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



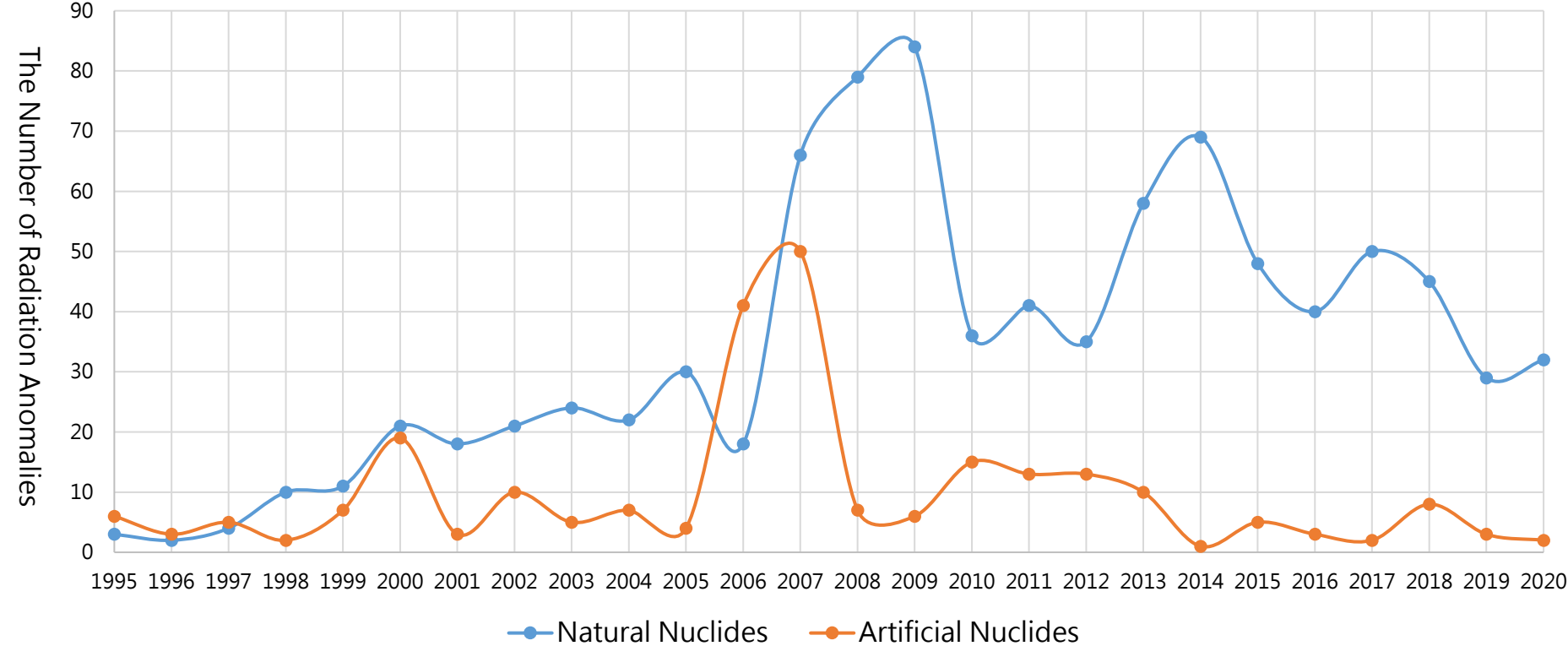
(2) Statistics of Nuclides in Radiation Anomalies Found in the Steel Plants over the Years

Nuclides \ Year	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

Nuclides \ Year	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

Nuclides \ Year	2017	2018	2019	2020	Total
Natural Nuclides	50	45	29	32	896
Artificial Nuclides	2	8	3	2	250
Total	52	53	32	34	1,146

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



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

Types of Radiation Anomalies \ Year	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 ^{Remarks}	3	2	4	10	13	28	20	23	24	25	29
Total	9	5	9	12	18	40	21	31	29	29	34

Types of Radiation Anomalies \ Year	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 ^{Remarks}	50	77	82	85	37	44	40	60	69	49	41
Total	59	116	86	90	51	54	48	68	70	53	43

Types of Radiation Anomalies \ Year	2017	2018	2019	2020	Total
Radiation-Contaminated Steel Bars	2	1	0	1	101
Radiation Sources	0	4	6	1	74
Others ^{Remarks}	50	48	26	32	971

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

Total	52	53	32	34	1,146
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Statistics of the Types of Radiation Anomalies Found in the Steel Plants over the Years

