

Fission Reactor Records in the INIS Database

- A Bibliometric Study -

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Abstract

This study presents a statistical analysis of bibliographic records concerning fission reactor research and technology. The underlying bibliographic research was based on the more than 181 000 subject specific records which are contained in the INIS Bibliographic Database and it covers the time period from 1970 to 1999. The quantitative data in this report cover the distribution of reactor specific literature over subject sub-categories, country and language specific statistics, publication types and literary types.

We hope to provide useful statistics and scientific indicators for users of the INIS Bibliographic Database, for science managers, researchers, engineers, scientific editors, publishers and other decision makers in the field.

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FISSION REACTOR RELATED RECORDS IN THE INIS DATABASE

Fission reactor research and technology is one of the most important fields within the subject scope of the INIS database. Literature in fission reactor categories covers the following topics:

1. reactor theory, reactor physics calculation, in-pile experiments verifying reactor theory and calculations, computations of in-reactor processes;
2. design, construction, fabrication and performance (mechanical integrity, structural analysis, reliability, fracture mechanics) of reactor components and accessories, including cooling systems, coolants, shielding, pressure vessels, loading machines;
3. design, fabrication and performance of fuel pellets, fuel elements and fuel assemblies, fuel loading procedures;
4. fuel fabrication plants (regardless of type of fuel elements produced), including technical aspects of safety, decommissioning and dismantling;
5. systems for control and surveillance of reactors and nuclear power plants, including alarm systems, automatic shutdown systems, and automatic initiation of protective systems or actions;
6. elements of reactor and nuclear power plants control system, including drive units, control rods, safety rods and incorporated instrumentation;
7. reactor and reactor plant computerised control systems;
8. man-machine interaction problems in reactor control;
9. technical aspects of safety;
10. design, construction, performance, operation, decommissioning and dismantling of specific reactor types and related nuclear power plants as energy sources for electricity generation and other applications including fuel elements, components and accessories, but not control systems;
11. technical aspects of safety;
12. real accidents

A specific category is assigned to literature related to subjects 10-12 according to reactor type:

- power reactors, non-breeding, light water moderated, boiling water cooled (BWR, etc., types);
- power reactors, non-breeding, light water moderated, non-boiling water cooled (PWR, etc., types);
- power reactors, non-breeding, graphite moderated (GCR, AGR, HTGR, etc., types);
- power reactors, non-breeding, heavy water or otherwise moderated or unmoderated;
- power reactors, breeding;
- research, test, training, production, irradiation and materials testing reactors;
- mobile, propulsion, transportable and package reactors;
- process heat reactors.

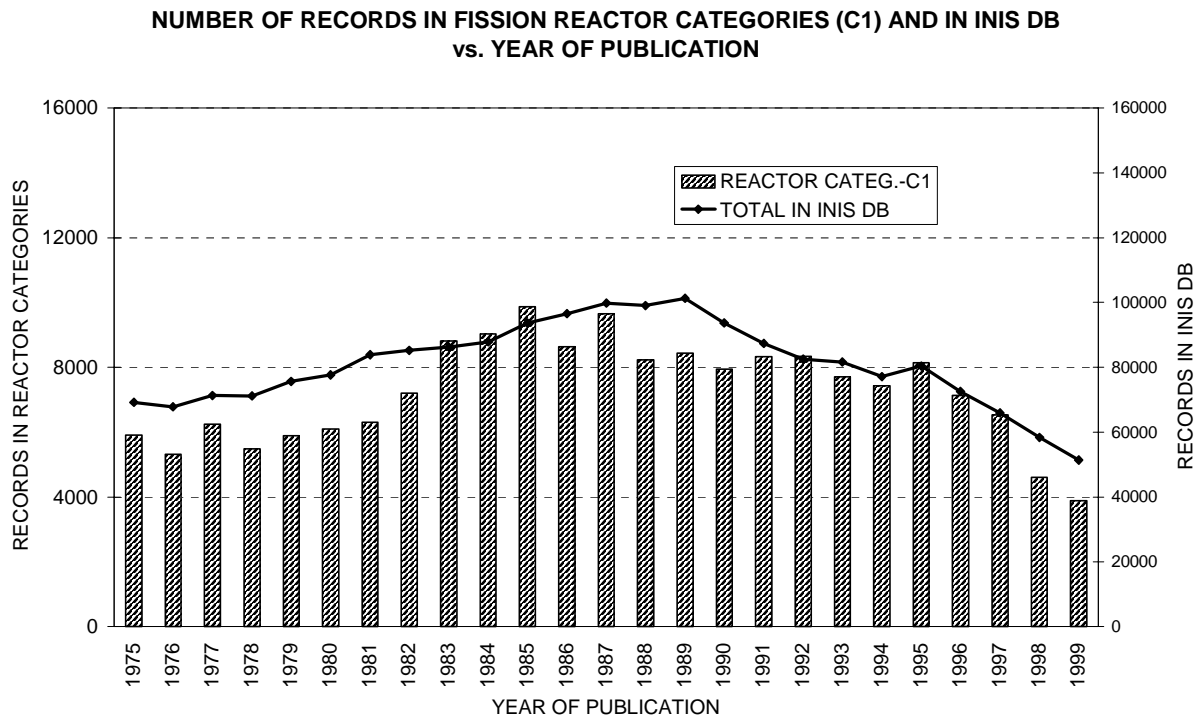
The analysis covers the period from 1970 till the end of 1999, and includes all bibliographic records that were available in the INIS Database at the end of 1999. The latest data CD taken into account was the 1997-1999/12 edition.

This study makes extensive use of the detailed subject categorization of the INIS records, which was in use until December 1999. From January 2000 on a new, much simplified subject categorization scheme has been commonly adopted by both INIS and ETDE.

For the time dependence analysis, records published before 1975 were not included, since records collected during the start-up period of the database, from 1970-1974, suffer from incomplete literature coverage. The following 25 years, from 1975-1999, were considered to be relevant for this analysis, although records input in 1998 and 1999 are incomplete due to the lead-in time into the database. The graphical data related to the years 1998 and 1999 are in fact extrapolated according to this time lag.

The total number of records in the INIS Database was 2,143,963 in December 1999 with 181,525 records in reactor categories (these are only the records having one of the mentioned reactor categories as their primary category). Therefore about 8.5% of all records in the INIS Database are in reactor categories. Figure 1, shows that this fraction has remained almost constant during the last 25 years.

Figure 1



Origin of input

During the period covered, the records in the INIS database were contributed by 109 member countries and 17 participating international organisations. Of these only 87 countries/organisations have sent records classified in reactor categories as shown in Table 1.

The highest contribution comes generally from the countries which have the most developed nuclear programs and operate most nuclear power plants, namely the USA (36%), Japan (12%), Germany (11%), the United Kingdom (6.5%), etc. Exceptions are the IAEA, and the Netherlands which are placed among the foremost ten contributors. This is, in the case of the IAEA, due to the Agency's mandate to promote nuclear energy and in the case of the Netherlands it is due to the countries well developed scientific publishing industry.

The contribution of INIS Member states/organisations in fission reactor categories (primary categories C1) compared to their overall contribution to the INIS Database is shown in Table 2. and Figure 2.

A different picture (Figure 3) emerges if one ranks the inputting countries/organizations by the fraction of their own records that fall into the reactor categories. Some of the countries placed at the top of the list are not the most developed nuclear countries even if the contribution of records in reactor categories is significant compared to their total input included in the INIS Database. Examples are Slovenia (having only one nuclear power plant, and one experimental reactor), Saudi Arabia (having no fission reactors), Venezuela (having one shutdown experimental reactor), Greece (having 2 operational and one shutdown experimental reactor), Yugoslavia (having two experimental reactors), Vietnam (one operational experimental reactor), Cuba (no fission reactors).

Table 1. Number of records per INIS member state/organization in nuclear reactor categories (C1)

	COUNTRY/ORGANIZATION OF INPUT	No. Rec.			
1	UNITED-STATES	65455			
2	JAPAN	22367			
3	GERMANY	19863			
4	UNITED-KINGDOM	11810			
5	IAEA	9388			
6	FRANCE	7861			
7	NETHERLANDS	6937			
8	USSR	5414			
9	CANADA	3877			
10	CZECHOSLOVAKIA	3722			
11	BRAZIL	2596			
12	SWITZERLAND	2321			
13	CHINA	2094			
14	CEC	1890			
15	INDIA	1770			
16	RUSSIAN FEDERATION	1664			
17	KOREA-REPUBLIC-OF	1215			
18	GERMANY-DEM-REP	971			
19	NEA	864			
20	CZECH-REPUBLIC	859			
21	HUNGARY	749			
22	SWEDEN	733			
23	FINLAND	662			
24	SPAIN	494			
25	ISRAEL	460			
26	AUSTRALIA	439			
27	ITALY	388			
28	BULGARIA	372			
29	ROMANIA	372			
30	POLAND	362			
31	AUSTRIA	321			
32	DENMARK	298			
33	SOUTH AFRICA	295			
34	ARGENTINA	276			
35	EGYPT	230			
36	BELGIUM	224			
37	CMEA	206			
38	YUGOSLAVIA	198			
39	UKRAINE	149			
40	NORWAY	140			
41	KAZAKHSTAN	137			
42	SLOVAKIA	121			
43	PAKISTAN	101			
44	CUBA	94			
45	MEXICO	74			
46	IRAN	64			
47	INDONESIA	60			
48	CROATIA	53			
49	LITHUANIA	53			
50	TURKEY	44			
51	MALAYSIA	41			
52	BELARUS	34			
53	VIET-NAM	32	71	PORTUGAL	7
54	IRAQ	30	72	LIBYAN-JAMAHIRIYA	6
55	SLOVENIA	29	73	WEC	6
56	JINR	20	74	UN	5
57	PHILIPPINES	20	75	BANGLADESH	5
58	PERU	19	76	VENEZUELA	5
59	CHILE	19	77	PEOPLES-REP-KOREA	4
60	GREECE	18	78	AAEA	4
61	SYRIAN-ARAB-REPUBLIC	12	79	ZAIRE	4
62	MACEDONIA	12	80	NEW-ZEALAND	3
63	THAILAND	11	81	CERN	2
64	GHANA	11	82	URUGUAY	2
65	ISO	11	83	ARMENIA	2
66	COLOMBIA	10	84	UZBEKISTAN	1
67	ICSTI	8	85	NIGERIA	1
68	SAUDI ARABIA	8	86	LEBANON	1
69	MOROCCO	7	87	OECD	1
70	ALGERIA	7		TOTAL	181525

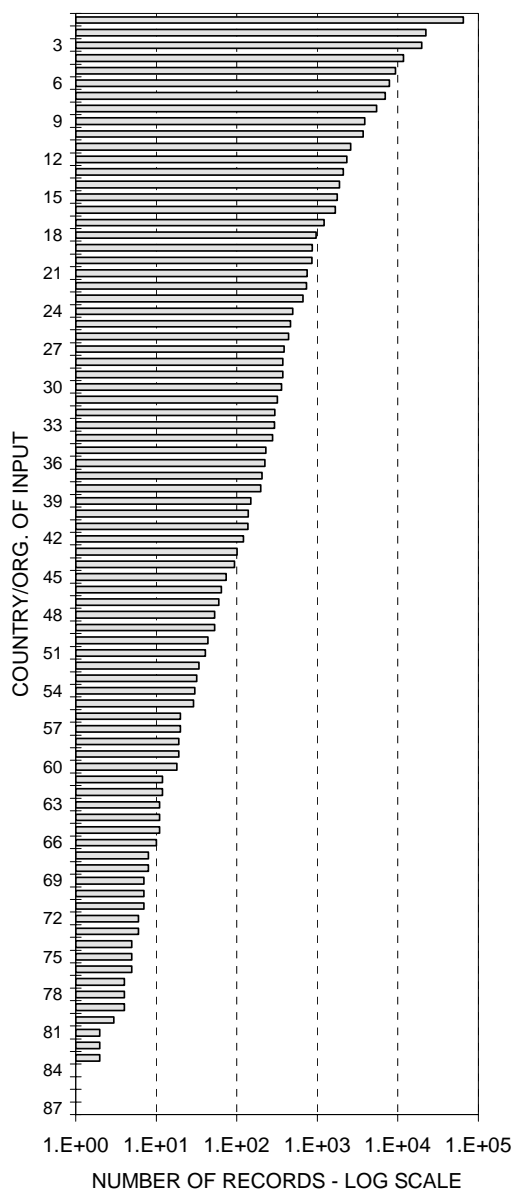


Table 2. Number of records per INIS member state/organization in nuclear reactor categories (C1) and total contribution to the INIS Database

COUNTRY/ORGANIZATION OF INPUT	REACTOR CATEG.	(%)	INIS DB	(%)	COUNTRY/ORGANIZATION OF INPUT	REACTOR CATEG.	(%)	INIS DB	(%)
UNITED-STATES	65455	36	728783	34	SYRIAN-ARAB-REPUBLIC	12	0	635	0
JAPAN	22367	12	123085	6	MACEDONIA	12	0	292	0
GERMANY	19863	11	164866	8	THAILAND	11	0	548	0
UNITED-KINGDOM	11810	7	151879	7	GHANA	11	0	147	0
IAEA	9388	5	58810	3	ISO	11	0	125	0
FRANCE	7861	4	78278	4	COLOMBIA	10	0	95	0
NETHERLANDS	6937	4	175710	8	ICSTI	8	0	337	0
USSR	5414	3	214144	10	SAUDI ARABIA	8	0	46	0
CANADA	3877	2	21279	1	MOROCCO	7	0	161	0
CZECHOSLOVAKIA	3722	2	24429	1	ALGERIA	7	0	146	0
BRAZIL	2596	1	43096	2	PORTUGAL	7	0	134	0
SWITZERLAND	2321	1	25133	1	LIBYAN-JAMAHIRIYA	6	0	35	0
CHINA	2094	1	28434	1	WEC	6	0	49	0
CEC	1890	1	7254	0	UN	5	0	944	0
INDIA	1770	1	30644	1	BANGLADESH	5	0	94	0
RUSSIAN FEDERATION	1664	1	39487	2	VENEZUELA	5	0	32	0
KOREA-REPUBLIC-OF	1215	1	4878	0	PEOPLES-REP-KOREA	4	0	41	0
GERMANY-DEM-REP	971	1	24064	1	AAEA	4	0	33	0
NEA	864	0	4297	0	ZAIRE	4	0	28	0
CZECH-REPUBLIC	859	0	4077	0	NEW-ZEALAND	3	0	771	0
HUNGARY	749	0	21490	1	CERN	2	0	2205	0
SWEDEN	733	0	15599	1	URUGUAY	2	0	96	0
FINLAND	662	0	3332	0	ARMENIA	2	0	86	0
SPAIN	494	0	3446	0	UZBEKISTAN	1	0	1378	0
ISRAEL	460	0	6464	0	NIGERIA	1	0	109	0
AUSTRALIA	439	0	18757	1	LEBANON	1	0	92	0
ITALY	388	0	15577	1	OECD	1	0	32	0
BULGARIA	372	0	7577	0	IRELAND	0	0	610	0
ROMANIA	372	0	4848	0	ESTONIA	0	0	218	0
POLAND	362	0	20611	1	IEA	0	0	179	0
AUSTRIA	321	0	13243	1	JORDAN	0	0	154	0
DENMARK	298	0	11161	1	WHO	0	0	139	0
SOUTH AFRICA	295	0	8084	0	SUDAN	0	0	102	0
ARGENTINA	276	0	2032	0	ECUADOR	0	0	89	0
EGYPT	230	0	2639	0	SINGAPORE	0	0	64	0
BELGIUM	224	0	2105	0	MONGOLIA	0	0	57	0
CMEA	206	0	1324	0	CYPRUS	0	0	53	0
YUGOSLAVIA	198	0	1263	0	TUNISIA	0	0	41	0
UKRAINE	149	0	6735	0	SRI-LANKA	0	0	40	0
NORWAY	140	0	3788	0	COSTA-RICA	0	0	35	0
KAZAKHSTAN	137	0	1093	0	CTBTO	0	0	32	0
SLOVAKIA	121	0	1889	0	UNIDO	0	0	30	0
PAKISTAN	101	0	1930	0	QATAR	0	0	29	0
CUBA	94	0	739	0	MOLDOVA	0	0	25	0
MEXICO	74	0	2230	0	GUATEMALA	0	0	24	0
IRAN	64	0	839	0	PARAGUAY	0	0	22	0
INDONESIA	60	0	857	0	FAO	0	0	20	0
CROATIA	53	0	435	0	MYANMAR	0	0	17	0
LITHUANIA	53	0	364	0	KENYA	0	0	16	0
TURKEY	44	0	620	0	NICARAGUA	0	0	16	0
MALAYSIA	41	0	1295	0	ZAMBIA	0	0	14	0
BELARUS	34	0	1729	0	ETHIOPIA	0	0	12	0
VIET-NAM	32	0	213	0	ICRP	0	0	11	0
IRAQ	30	0	354	0	ALBANIA	0	0	9	0
SLOVENIA	29	0	114	0	BOLIVIA	0	0	8	0
JINR	20	0	2148	0	DOMINICAN-REPUBLIC	0	0	1	0
PHILIPPINES	20	0	791	0	MADAGASCAR	0	0	1	0
PERU	19	0	342	0	MALI	0	0	1	0
CHILE	19	0	336	0					
GREECE	18	0	112	0					
					TOTAL	181525		2151892	

Figure 2

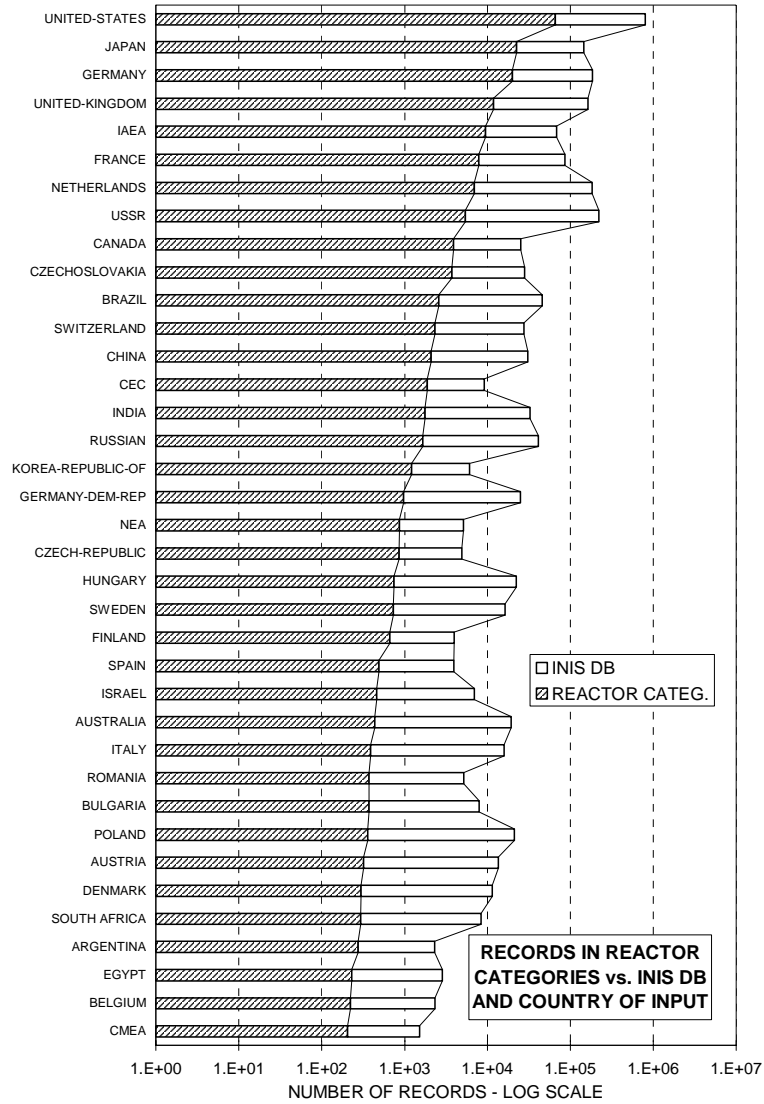
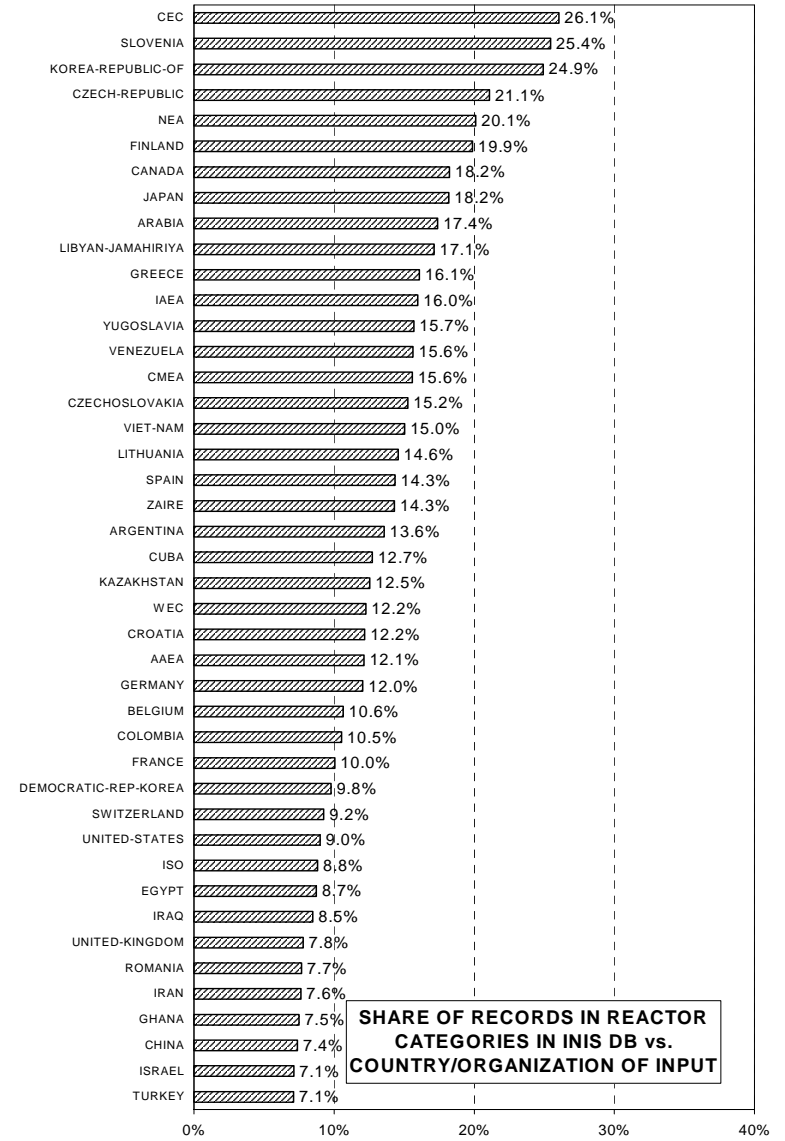


Figure 3



Languages

While the INIS Bibliography contains records in fission reactor categories in 39 languages, only five languages, English (67%), German (9.5%), Japanese (8.9%), French (3.6%) and Czech (1.6%) cover 96% of records (Table 3., Figure 4), making English the predominant language. The contribution of English language records to the total number of records in INIS Database is 72% (Figure 5). As this makes the share of all the other languages almost negligible one is lead to conclude that many authors from non-English speaking countries are submitting their publications in English, i.e. that the language of research and technology in fission reactors is English. This fact is evident from Table 4, showing the share of records input in English by non-English speaking countries.

Table 3. Number of records per language of input in nuclear reactor subject categories (C1)

	LANGUAGE OF INPUT	No. of Records Reactor Cat.	No. of Records INIS DB
1	ENGLISH	122899	1562851
2	GERMAN	17351	106992
3	JAPANESE	16240	71883
4	RUSSIAN	8049	253866
5	FRENCH	6596	49362
6	CZECH	2966	14410
7	PORTUGUESE	1853	28569
8	CHINESE	1542	20828
9	SPANISH	940	8723
10	SLOVAK	771	3695
11	KOREAN	724	3417
12	HUNGARIAN	458	3334
13	SWEDISH	391	2372
14	DUTCH	371	4433
15	POLISH	225	6937
16	ITALIAN	212	2507
17	BULGARIAN	196	4431
18	SERBIAN	165	895
19	FINNISH	138	917
20	ROMANIAN	90	1094
21	NORWEGIAN	72	1484
22	INDONESIAN	45	712
23	DANISH	40	897
24	PERSIAN	35	452
25	HEBREW	29	405
26	ARABIC	26	1167
27	TURKISH	21	198
28	SLOVENIAN	20	67
29	AFRIKAANS	19	712
30	LITHUANIAN	19	206
31	UKRAINIAN	12	1506
32	MACEDONIAN	10	215
33	THAI	8	445
34	IRANIAN	5	49
35	GREEK	4	47
36	VIETNAMESE	4	53
37	HINDU	3	38
38	MALAY	3	172
39	BURMESE	1	5

Figure 4

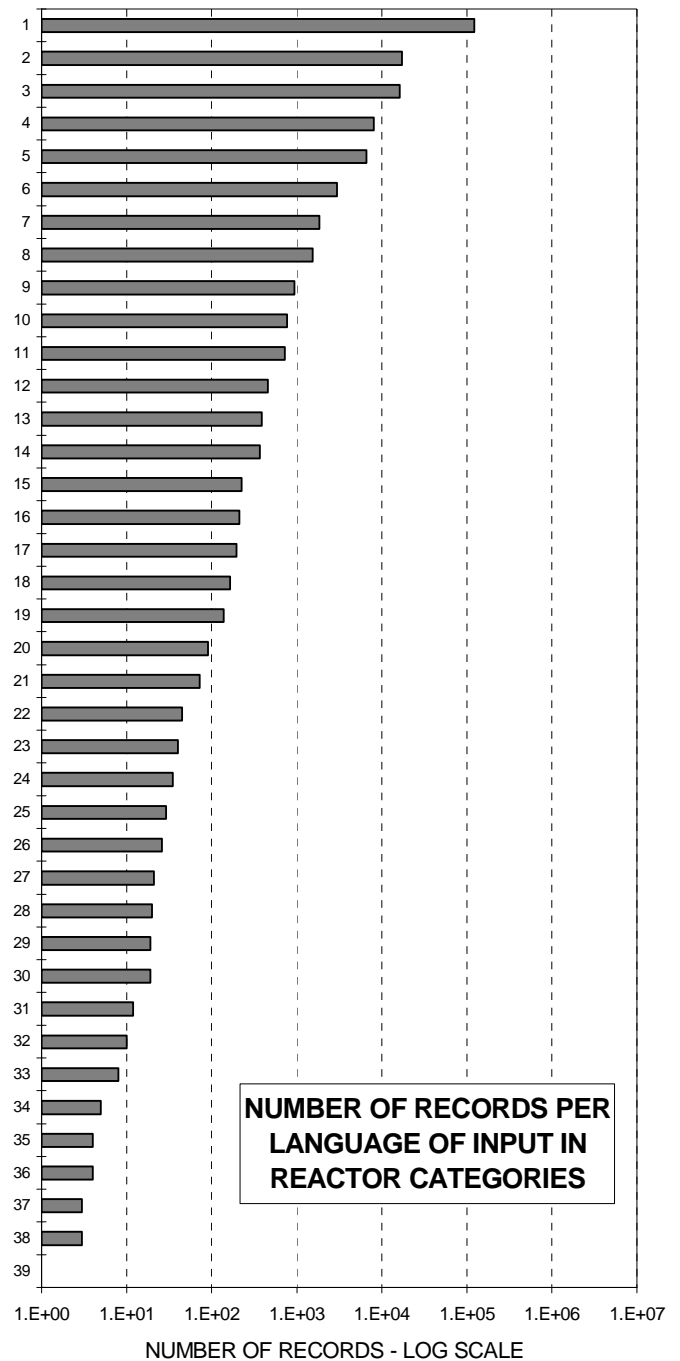


Figure 5

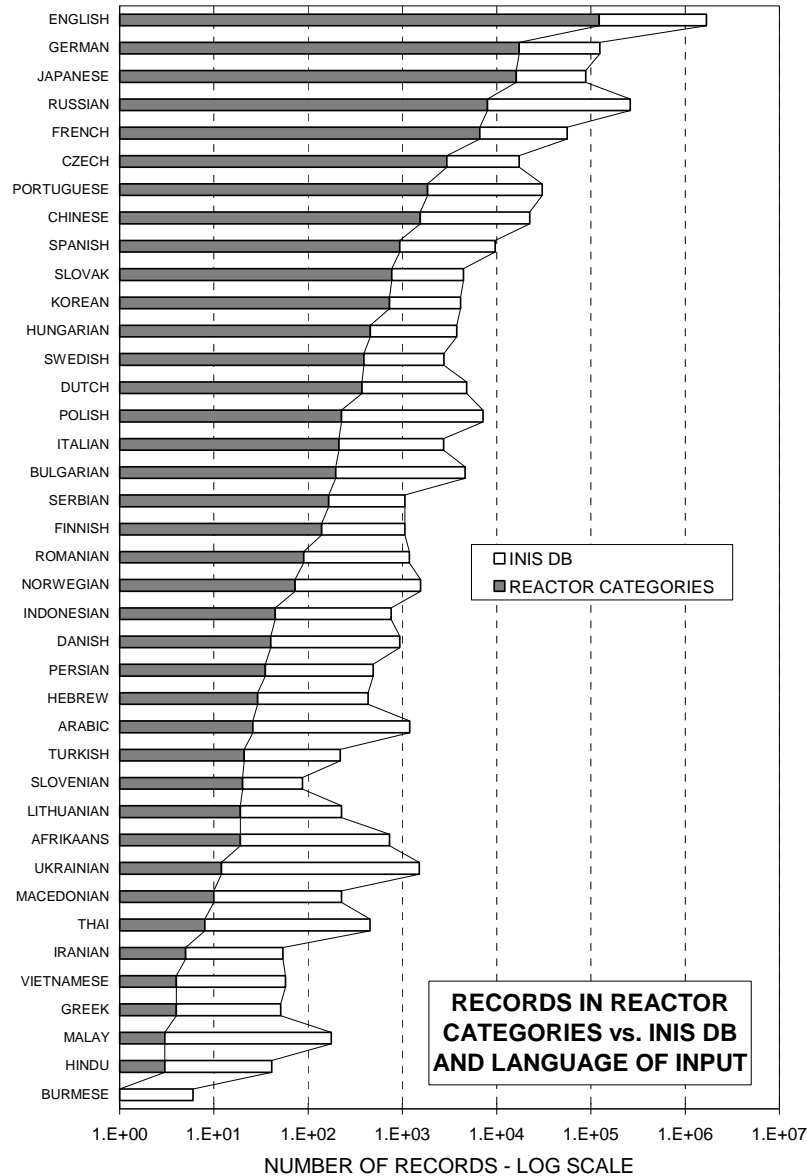


Table 4. Share of records in reactors categories submitted in English by non-English speaking country of input

Country of input	(%)	Country of input	(%)
SAUDI-ARABIA	100	AUSTRIA	45
BANGLADESH	100	JINR	45
CROATIA	100	KOREA-REP-OF	41
EGYPT	100	CZECH-REPUBLIC	40
GHANA	100	INDONESIA	40
ICSTI	100	IRAN	39
LEBANON	100	HUNGARY	37
LIBYAN-ARAB-JAM.	100	FRANCE	33
NIGERIA	100	YUGOSLAVIA	31
PHILIPPINES	100	BULGARIA	30
SLOVENIA	100	POLAND	30
UZBEKISTAN	100	PORTUGAL	29
NEA	96	LITHUANIA	28
ISRAEL	94	SPAIN	28
NETHERLANDS	93	JAPAN	27
VIET-NAM	91	THAILAND	27
MALAYSIA	90	CHINA	26
ISO	82	BRAZIL	26
DENMARK	81	GERMANY	22
SWITZERLAND	79	VENEZUELA	20
FINLAND	79	ARGENTINA	20
AAEA	75	MACEDONIA	17
WEC	75	MOROCCO	14
ROMANIA	74	KAZAKHSTAN	13
GREECE	72	CZECHOSLOVAKIA	13
BELGIUM	72	GERMANY-DEM-REP	11
IRAQ	63	UKRAINE	9
SLOVAKIA	59	RUSSIAN FEDERATION	8
ITALY	54	CHILE	5
TURKEY	52	CUBA	3
SWEDEN	52	MEXICO	1
ZAIRE	50	USSR	1
NORWAY	49		

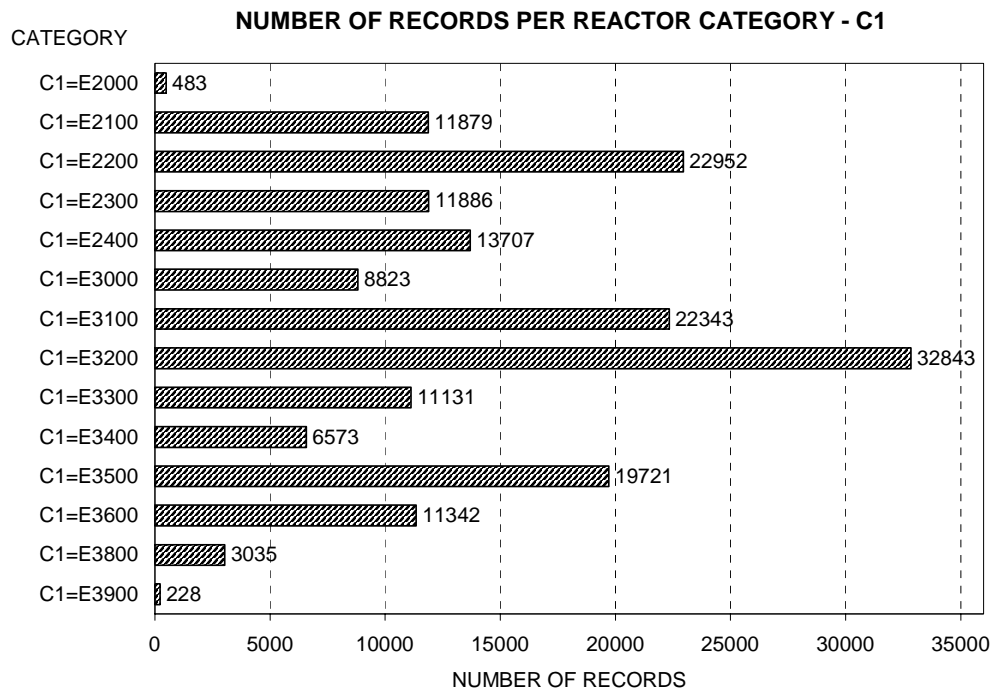
Subject Categories

Every record in the INIS Database is assigned a primary subject category (C1). The subject categories for records related to fission reactors research and technology are:

- E2000 - FISSION REACTORS (GENERAL)
 - E2100 - Reactor Theory and Calculation
 - E2200 - Reactor Components and Accessories
 - E2300 - Reactor Fuels
 - E2400 - Reactor Control Systems
- E3000 - SPECIFIC FISSION REACTOR TYPES AND THEIR ASSOCIATED PLANTS
 - E3100 - Power Reactors, Non-Breeding, Light Water Moderated, Boiling Water Cooled (BWR, etc., types)
 - E3200 - Power Reactors, Non-Breeding, Light Water Moderated, Non-Boiling Water Cooled (PWR, etc., types)
 - E3300 - Power Reactors, Non-Breeding, Graphite Moderated (GCR, AGR, HTGR, etc., types)
 - E3400 - Power Reactors, Non-Breeding, Heavy Water or Otherwise Moderated or Unmoderated
 - E3500 - Power Reactors, Breeding
 - E3600 - Research, Test, Training, Production, Irradiation and Materials Testing Reactors
 - E3800 - Mobile, Propulsion, Transportable and Package Reactors
 - E3900 - Process Heat Reactors

Categories E2000 (fission reactors, general) and E3000 (specific fission reactor types and their associated plants) are major categories and the others are sub-categories, describing more specifically the subject concerned.

Figure 6

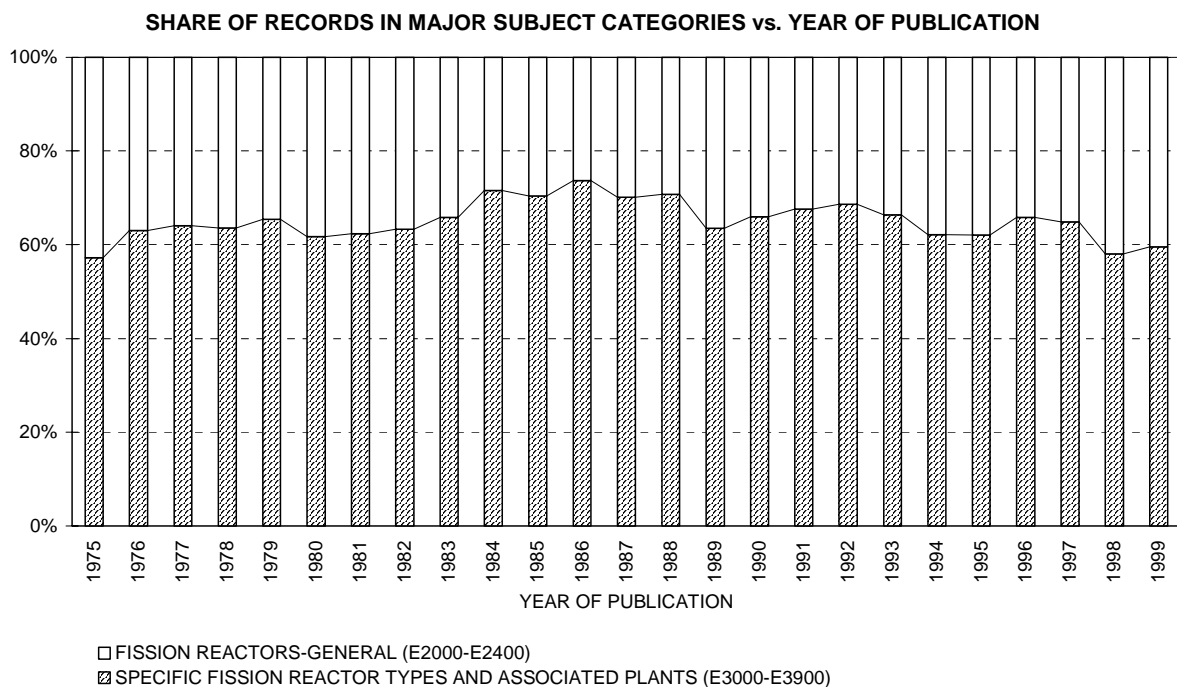


The present analysis is concerned with records which have fission reactor categories assigned as their primary category. The number of records for each of the reactor categories are shown in Figure 6. Note that the number of records in the major categories (E2000, E3000), is much smaller than the number of records with more specific subject category description. This is a direct consequence of the general rule that each record must be assigned to the most specific possible subject category.

Within the major category E2000, the number of records dealing with reactor components and accessories (E2200) is significant. This shows the importance of reactor safety items which are covered in this category (components mechanical integrity, structural analysis, reliability, fracture mechanics of reactor components and accessories, cooling systems, shielding). In the second major category (E3000) the biggest number of records is related to non-breeding, light water moderated power reactors, non-boiling water cooled reactors, PWR type and WWER type reactors (E3200). This is certainly due to the fact that this covers the most numerous types of operating power reactors in nuclear power plants. Second on the list is the number of records in the field of non-breeding, light water moderated, boiling water cooled power reactors, BWR type (E3100), followed by the number of records related to breeding power reactors (E3500). Breeding power reactors are not so common, but a great deal of effort has been applied to this technology.

The distribution of records between general (E2000-E2400) and specific fission reactor types and their associated plants (E3000-E3900) vs. year of publication is shown in Figure 7. Somewhat more than 60% of the records are related to specific reactor types and related nuclear power plants during the whole 25 year period. This means that there have been fewer publications dealing with general research of fission reactor theory, related calculations and numerical methods, reactor components, instrumentation and control systems, than with subjects related to specific reactor types. The prevailing number of publications is related to engineering and to fission reactor technology.

Figure 7



The time dependence of the share of records for each primary reactor category (C1) is detailed in Figure 8, giving an overall impression of the relative importance of each sub category.

The time dependence of the absolute number of records in major subject category "fission reactors - general" (E=2000 - E=2400) is shown in Figure 9.

Within this major category, 17% of the records are on average related to reactor theory and calculations (C1=E2100). This fraction was more than 20% from 1974 to 1982, then it decreased and remained almost constant (about 15%) the following ten years.

Figure 8

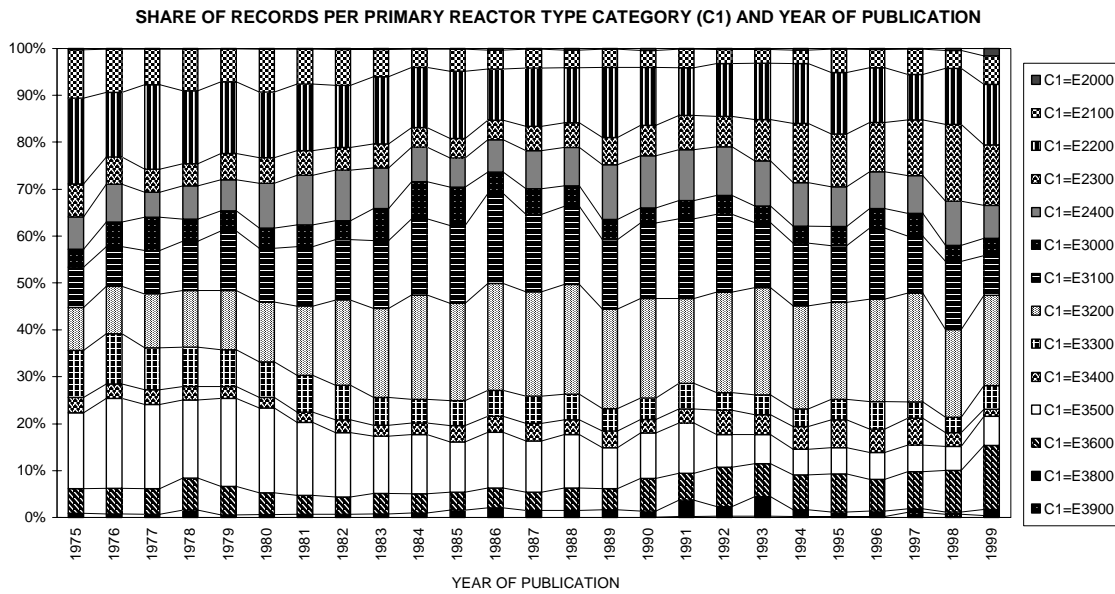
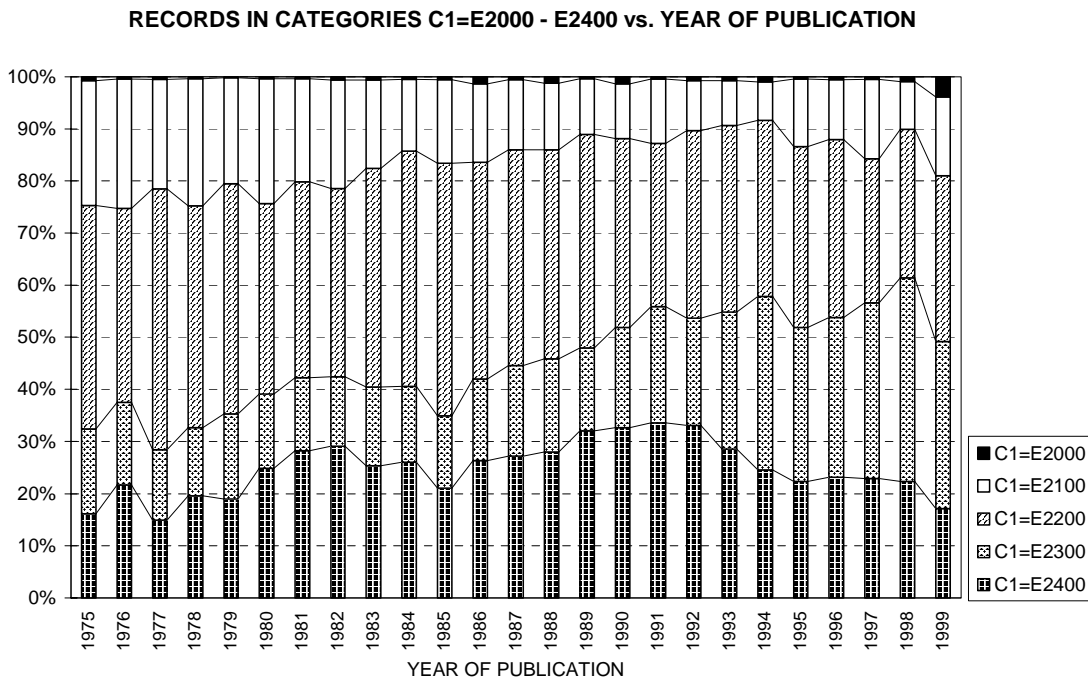


Figure 9



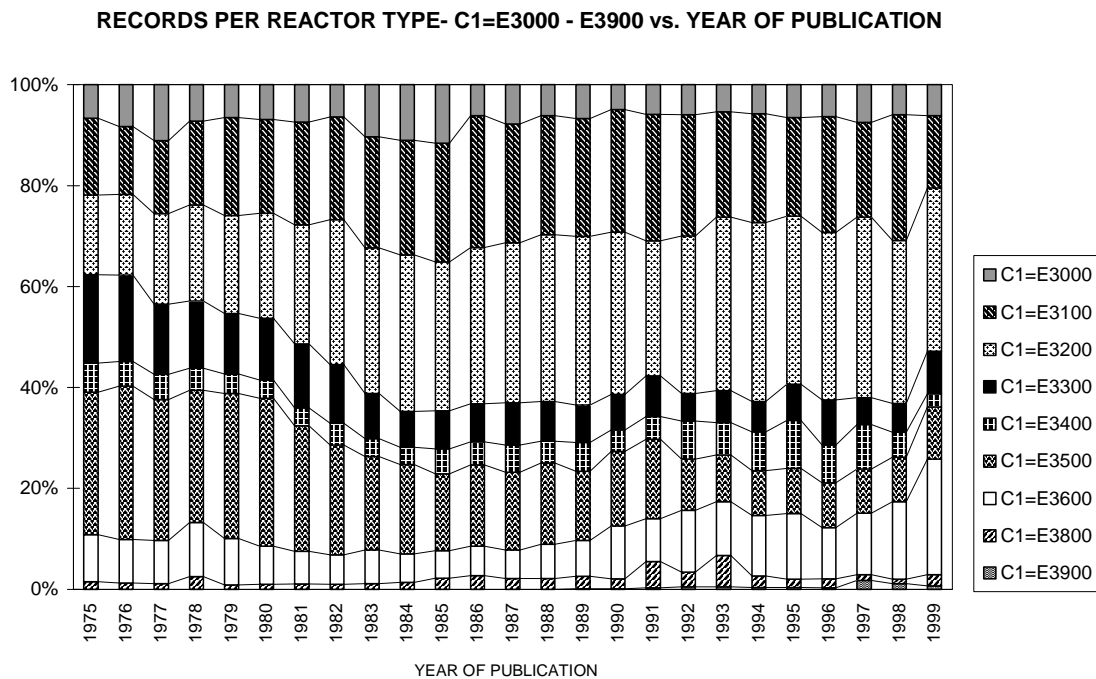
Records in the field of reactor components and accessories prevail (C1=E2200), achieving highest values (above 40%) in the period between 1982 and 1990. The average yield of these records during the last 25 years was 38%.

Records related to reactor fuels (C1=E2300) yield to 20% on the average, achieving highest values of about 30% from 1994 to 1999.

The number of records concerned with reactor control systems (C1=E2400) amounts to 24% on average, being more than 30% between 1988 and 1993. Since reactor control systems are related to reactor safety issues, one should note that this was the period after the Chernobyl accident.

The time dependence of the number of records per fission reactor type (categories from E3000 to E3900) is shown in Figure 10.

Figure 10



Within this major category, 27%, of records are in average related to power reactors, non-breeding, light water moderated, non-boiling water cooled, i.e. PWR type reactors (C1=E3200). This yield was above 30% from 1986 till 1999.

About 20%, on the average is related to category C1=E3100, covering publications related to power reactors, non-breeding, light water moderated, boiling water cooled (BWR type), achieving values up to 25% in the period from 1986 to 1992.

Records describing breeding power reactors (C1-E3500) amount to 18% on the average, with values between 20% and 30% from 1974 and 1982, decreasing to about 15% till 1991, and to around 10% till 1999.

The yield of records covering the field of power reactors, non-breeding, graphite moderated, GCR, AGR, HTGR types (C1=E3300) is 10% in average, achieving maximum values in the period from 1974 to 1982. This percentage decreases to less than 10% later on.

A similar fraction of records (10%) is related to research, test, training, production, irradiation and materials testing reactors (C1=E3600) achieving maximum values much later, from 1992 to 1999. The yield of records in power reactors, non-breeding, heavy water or otherwise moderated or unmoderated (C1-E3400) is 5% on the average.

The contribution of records in mobile, propulsion, transportable and package reactors (C1=E3800) amounts to 2%, while the number of records related to process heat reactors can almost be neglected.

While important conclusions can already be drawn from this part of the analysis alone, even more detailed data concerning the number of records for each reactor type category versus the total number of records in the reactor categories are presented in Annex 1, where each figure is related to one subject category and compared to the total number of records in reactor categories.

Figure 11 shows the number of records in non-breeding and breeding power reactors vs. year of publication, compared to the total number of records in reactor categories. During the period between 1982 and 1998 the number of records in non-breeding power reactors was more than 70% of the total number of records in power reactor categories.

Figure 11

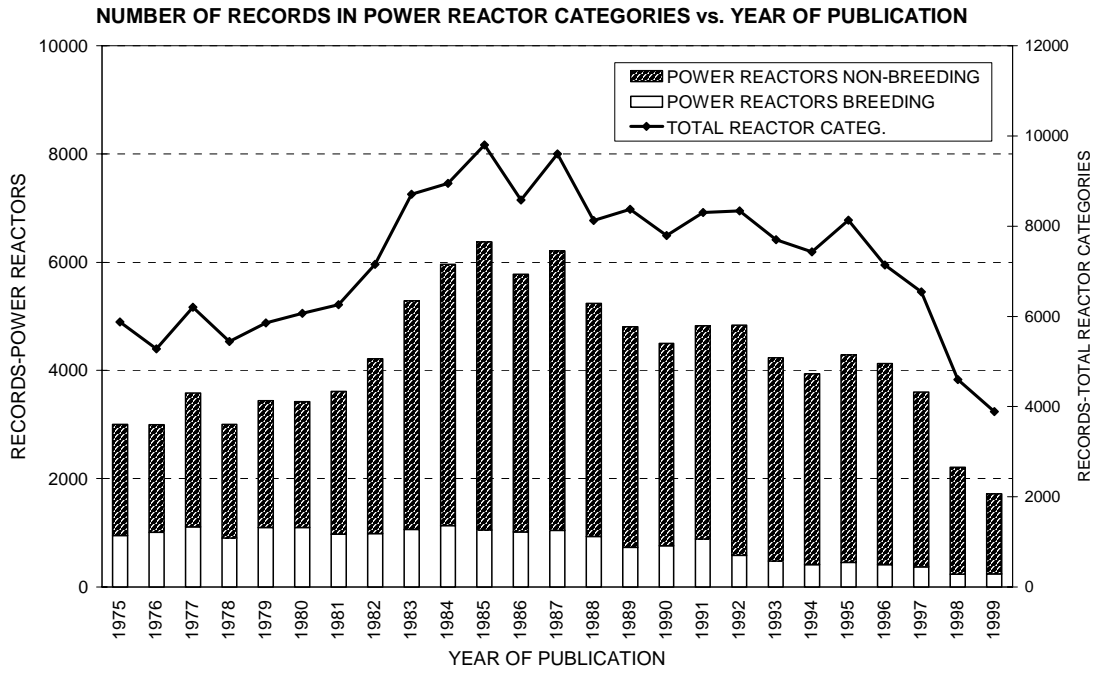


Figure 12

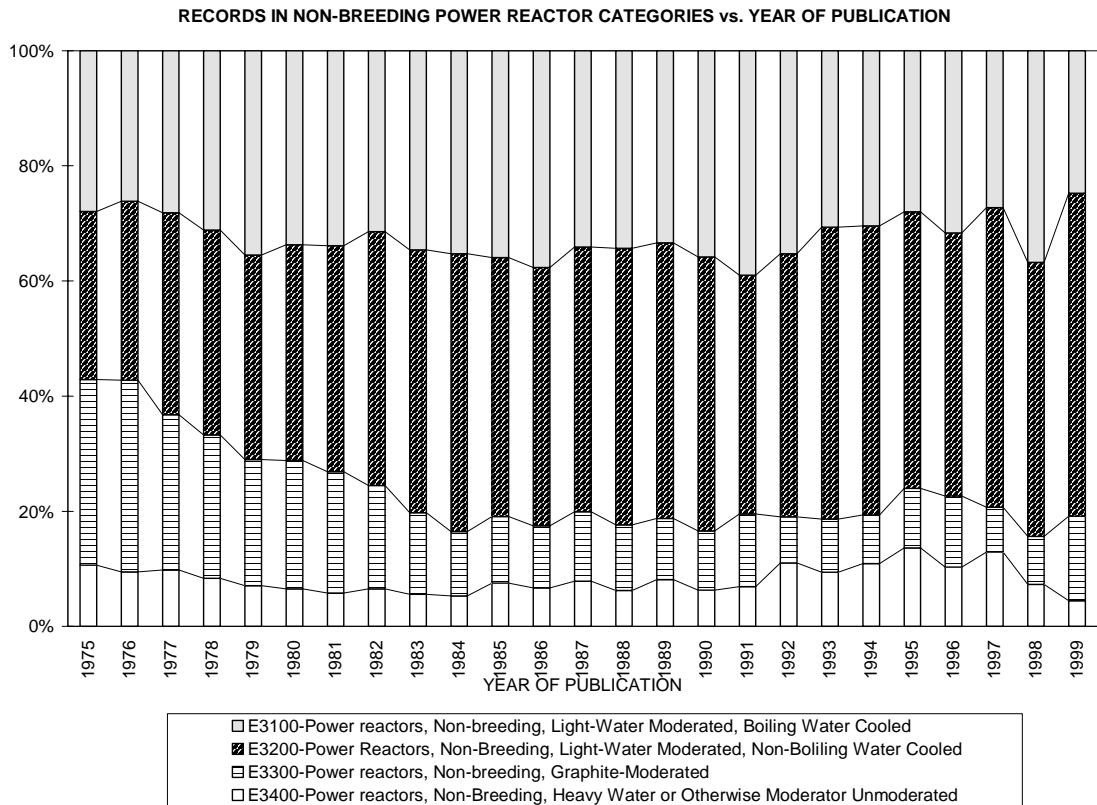


Figure 12. gives a more detailed representation of the number of records in non-breeding power reactors of different types and the share of these records in total number of records related to power reactors.

Primary and Secondary Subject Categories

INIS categorization scheme allows two categorization levels in order to describe more precisely the subject of each record. Secondary subject categories are assigned frequently because of the multidisciplinary character of the records in the field of fission reactors.

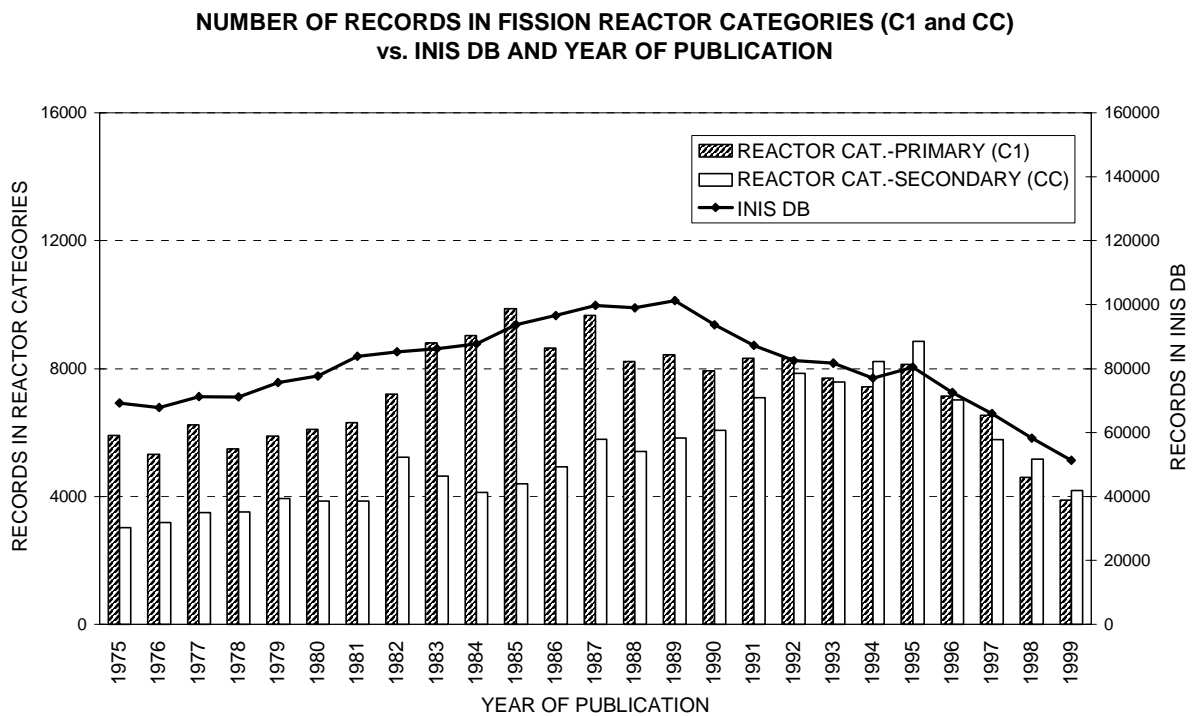
The total number of records with reactor categories as their primary category(C1) is 181,525, while the number of records having reactor categories as secondary category (CC) amounts to 135,363. More details are shown in Table 5.

Table 5.

Subject category	Primary C1	Primary + secondary C1+CC	Secondary CC
E2000	483	794	311
E2100	11879	14160	2281
E2200	22952	28205	5253
E2300	11886	18272	6386
E2400	13707	15887	2180
E3000	8823	11674	2851
E3100	22343	31492	9149
E3200	32843	56621	23778
E3300	11131	14624	3493
E3400	6573	8411	1838
E3500	19721	26880	7159
E3600	11342	15166	3824
E3800	3035	3584	549
E3900	228	369	141

The time evolution of the number of records with fission reactor subject categories as both primary and secondary categories is shown in Figure 13, compared to the total number of records in the INIS Database.

Figure 13



Publication types

Each record in the INIS Database indicates which type of publication it represents out of seven pre-defined types, which are: book, journal-article, report, miscellaneous (non-conventional literature), patent, computer-medium, translation and audio-visual material.

In Table 6 the number of records in fission reactor related categories is shown per publication type, and compared to the total number of records per publication type in the INIS Database. The share of record types in fission reactor categories is visualised in Figure 14. It turns out that almost one third of records are reports, one third are journal-articles and nearly 20% are books.

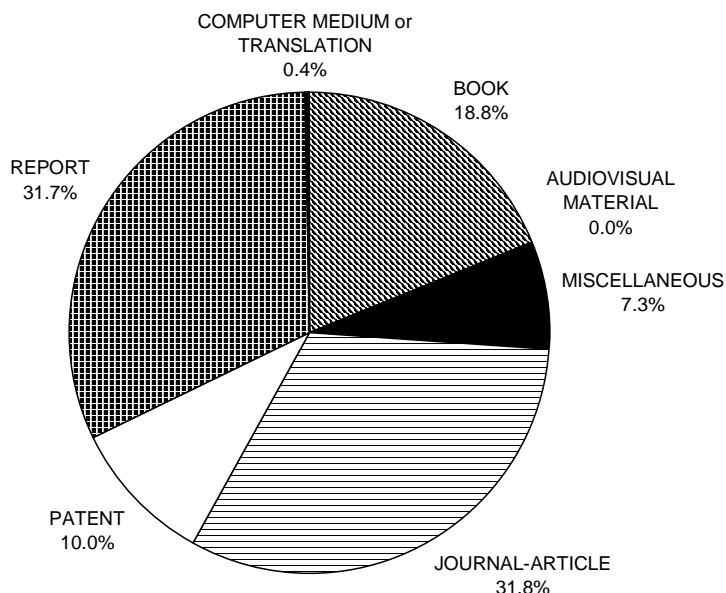
Table 6. Number of records per record type

RECORD TYPE	REACTOR Categories	INIS Database
BOOK	34306	281746
JOURNAL-ARTICLE	57868	1194924
REPORT	57802	465321
PATENT	18188	46308
MISCELLANEOUS	13348	163222
COMPUTER MEDIUM or TRANSLATION	666	13821
AUDIO-VISUAL MATERIAL	5	109

Whereas the share of fission reactor records in the INIS Database is only 8.5%, 12 % of all the books in the database are in the reactor category. In the reactor category there are also 12% of all reports, 39% of patent type records and 8% of the miscellaneous type records. Furthermore, 5% of all journal entries in the database and 5% of the computer media are in reactor categories.

Figure 14

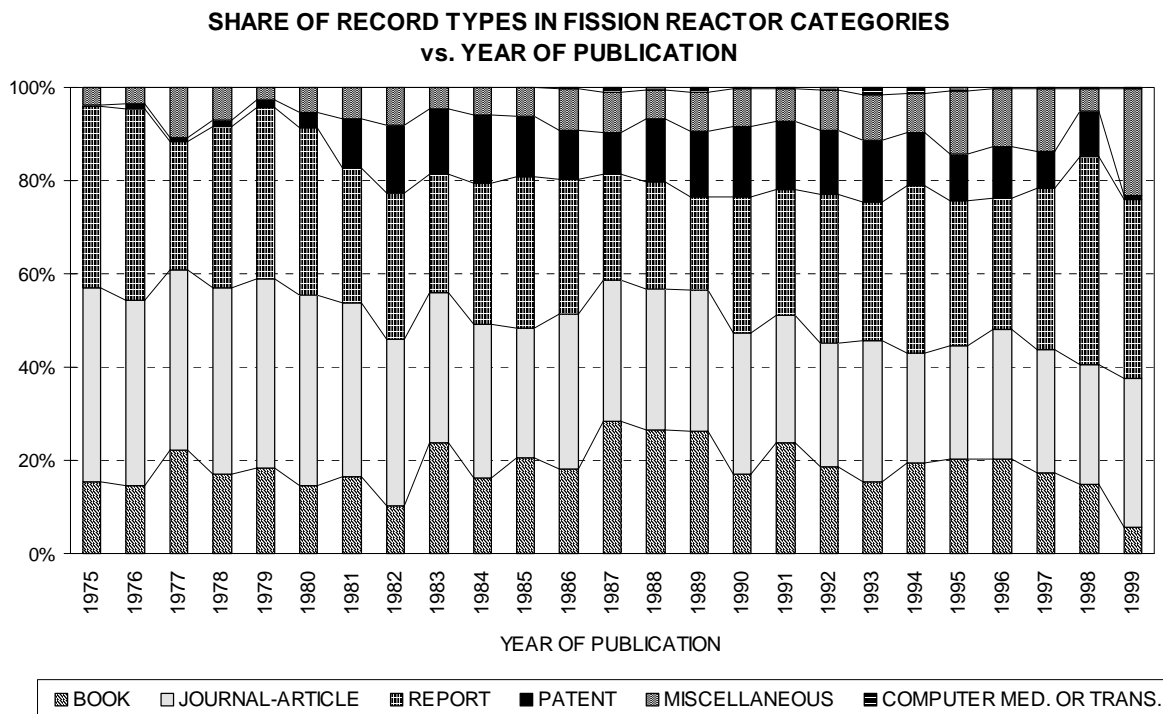
SHARE OF RECORD TYPES (%) IN FISSION REACTOR CATEGORIES



The fraction of record types in fission reactor related categories vs. year of publication is shown in Figure 15. Most numerous are journal-article type records (about 30%), representing high quality refereed

publications. Their share remains almost constant during the last 25 years. The share of report type items shows somewhat bigger variation during the same time period and is 30% in average. The number of book type records achieved its highest values between 1987 and 1991. The share of patent type and miscellaneous type records is small and computer medium type records are almost negligible.

Figure 15



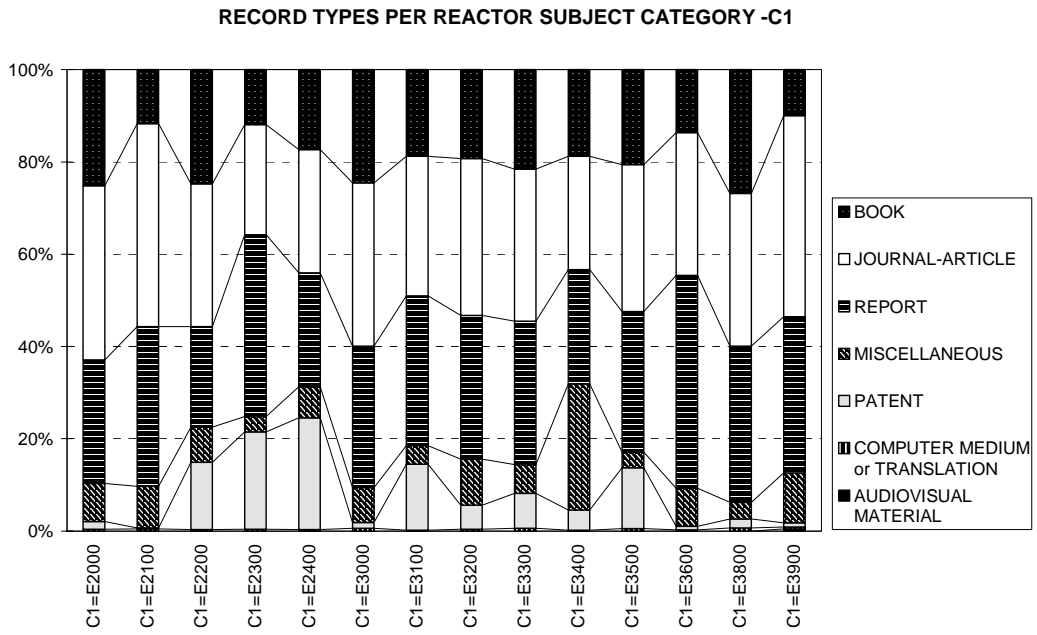
A more detailed time dependence of each record type compared to total number of records in reactor categories is shown in the figures of annex 2.

The number of record types per fission reactor subject category is shown in Table 7 and in Figure 16.

Table 7. Number of records per record type and reactor subject category

RECORD TYPE	BOOK	JOURNAL-ARTICLE	REPORT	PATENT	MISCELLANEOUS	COMPUTER MEDIUM or TRANSLATION	AUDIO-VISUAL MATERIAL
SUBJECT CATEGORY	B	J	R	P	I	T	F
E2000	122	183	130	8	40	2	0
E2100	1392	5255	4125	34	1071	51	1
E2200	5688	7145	5012	3354	1753	75	0
E2300	1423	2850	4692	2519	401	42	1
E2400	2380	3681	3384	3322	940	44	0
E3000	2173	3147	2724	110	668	55	1
E3100	4195	6771	7287	3202	888	40	0
E3200	6334	11231	10270	1710	3298	120	0
E3300	2406	3696	3479	844	702	68	1
E3400	1235	1619	1629	289	1800	9	1
E3500	4094	6309	6031	2618	669	108	0
E3600	1557	3508	5256	85	936	29	0
E3800	819	1013	1037	57	109	22	0
E3900	23	100	78	2	25	1	1
REACTOR CATEG.	34306	57868	57802	18188	13348	666	5

Figure 16



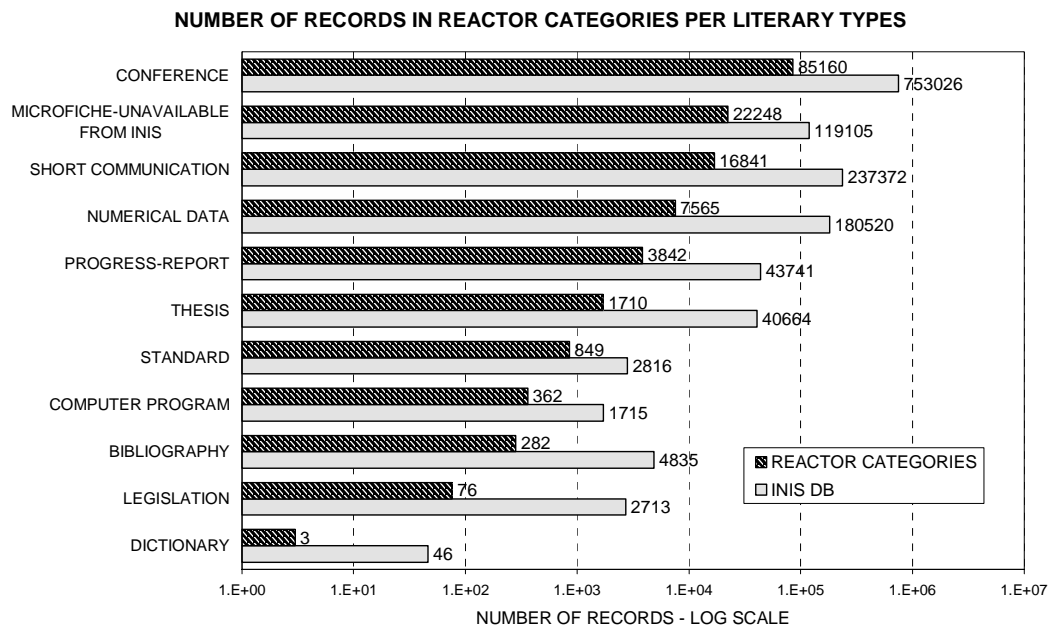
A more detailed distribution of record types by fission reactor categories is shown in annex 3.

Literary indicators

The following 10 literary types are defined: short communication, conference, dictionary, numerical data, legal material, thesis or dissertation, computer program description, standard or specification, progress report, bibliography. The full text of non-conventional literature is usually available from INIS unless it is marked with the special literary indicator "X" (unavailable from INIS).

The number of records in fission reactor categories per literary type are shown in Figure 17 in comparison with the respective number of records per literary type in the INIS database.

Figure 17



The majority of records in fission reactor categories (61%) were published as conference publications. The fraction of publications in form of short communications is 12%, numerical data 5.5%, progress reports 2.8%, and theses 1.2%. Only 16% of the records refer to unconventional literature which is not available from INIS.

A comparison of literary types of fission reactor items with all records in the INIS database, shows that 30% of standards in the database are concerned with fission reactors and 21% of computer codes are related to reactors. Furthermore, 11% of conference type records, 9% of progress reports, 7% of short communications, 7% of dictionaries, 6% of bibliography type records, 4% of thesis, 4% of numerical data type records and 3% of legislation type records are also in reactor subject categories. 19% of items of non-conventional literature which are not available from INIS are in reactor categories.

Each record in the database is assigned both a record type and a literary type. The following figures show the distribution of records per literary type for each of the record types for reactor categories as well as for the database as a whole. The number of book-type records per literary type is shown in Figure 18, illustrating that the majority of records are related to conference publications (89%). The number of journal-articles per literary type are shown in Figure 19, the majority of which were presented as conference papers (29%). The majority of report type records originate also from conference presentations (47%) as shown from Figure 20. Similarly, miscellaneous-type records (meaning non-conventional papers) per literary type, as shown in Figure 21, represent mainly (81%) conference papers.

Figures with the number of records per year of publication and per literary type are given in annex 4.

Figure 18

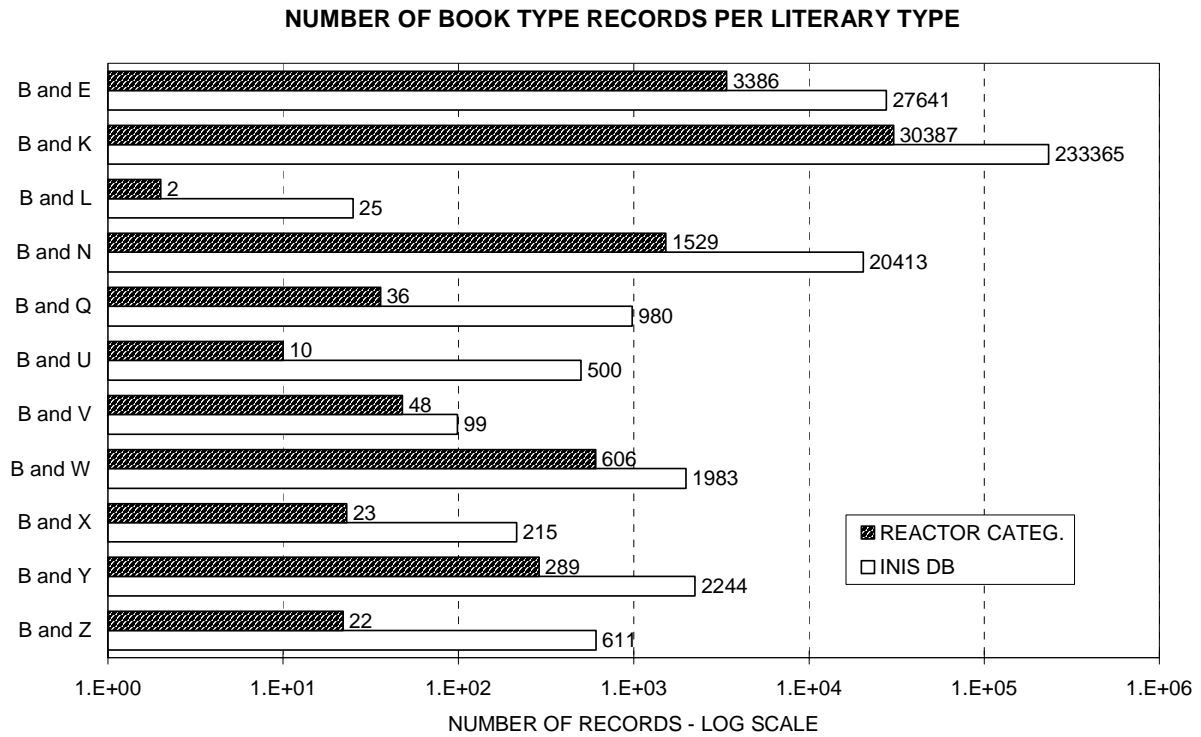
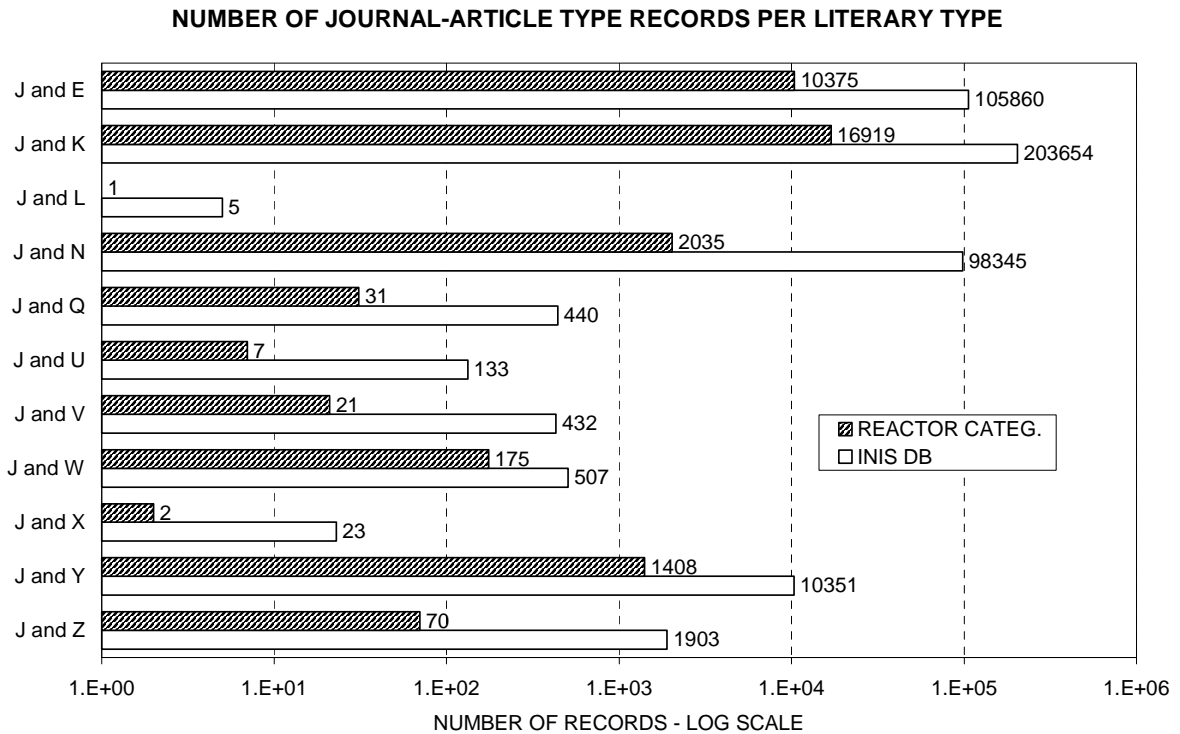


Figure 19



E - SHORT COMMUNICATION	K - CONFERENCE	L - DICTIONARY
N - NUMERICAL DATA	Q - LEGISLATION	U - THESIS
V - COMPUTER PROGRAM	W - STANDARD	X - MICROFICHE-UNAVAILABLE FROM INIS
Y - PROGRESS-REPORT	Z - BIBLIOGRAPHY	

Figure 20

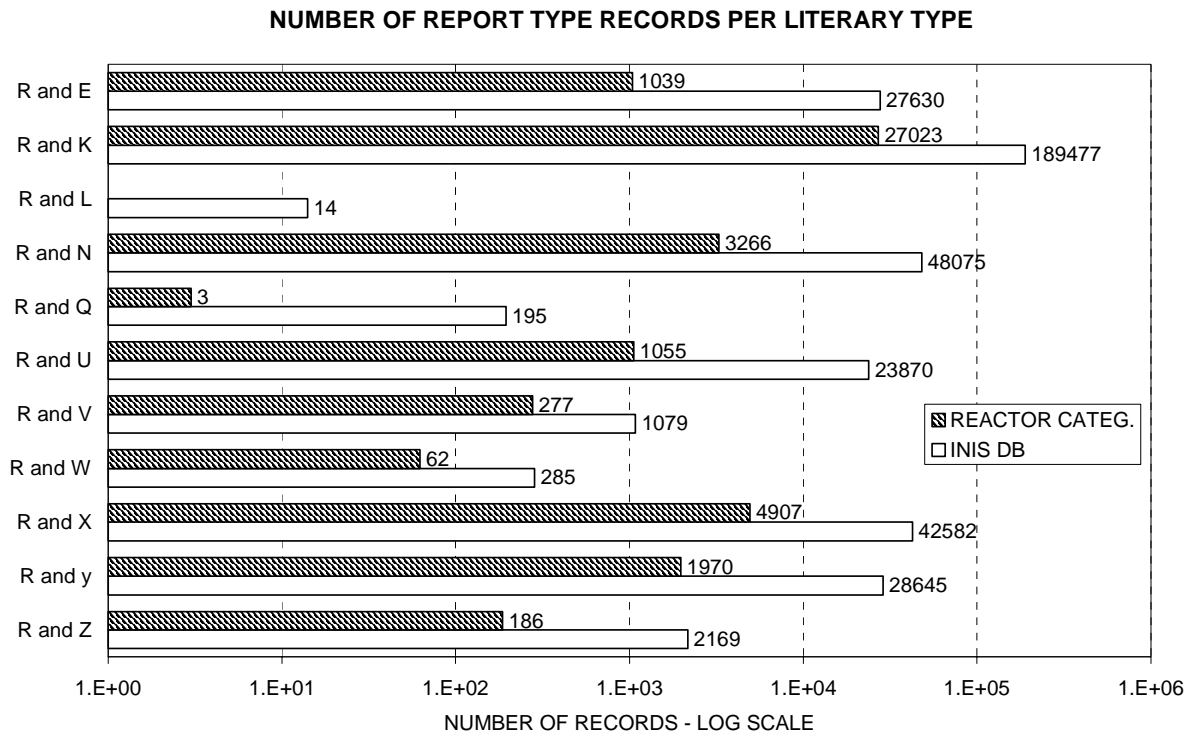
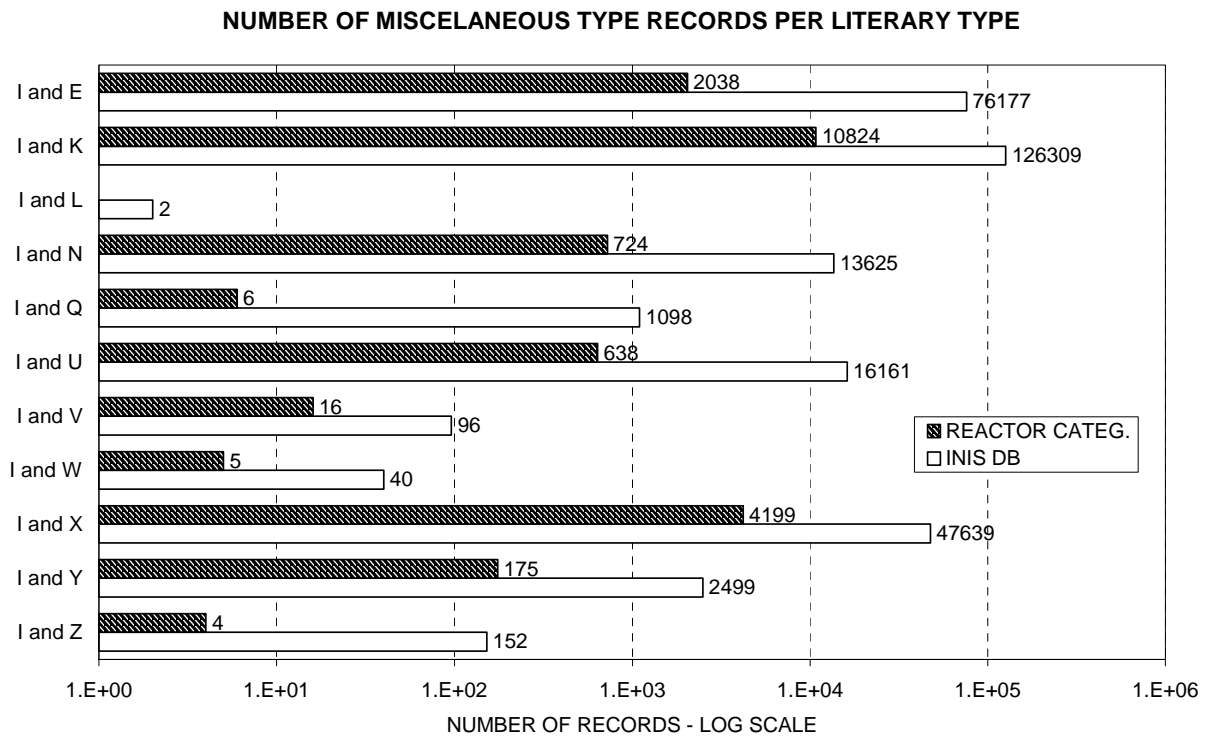
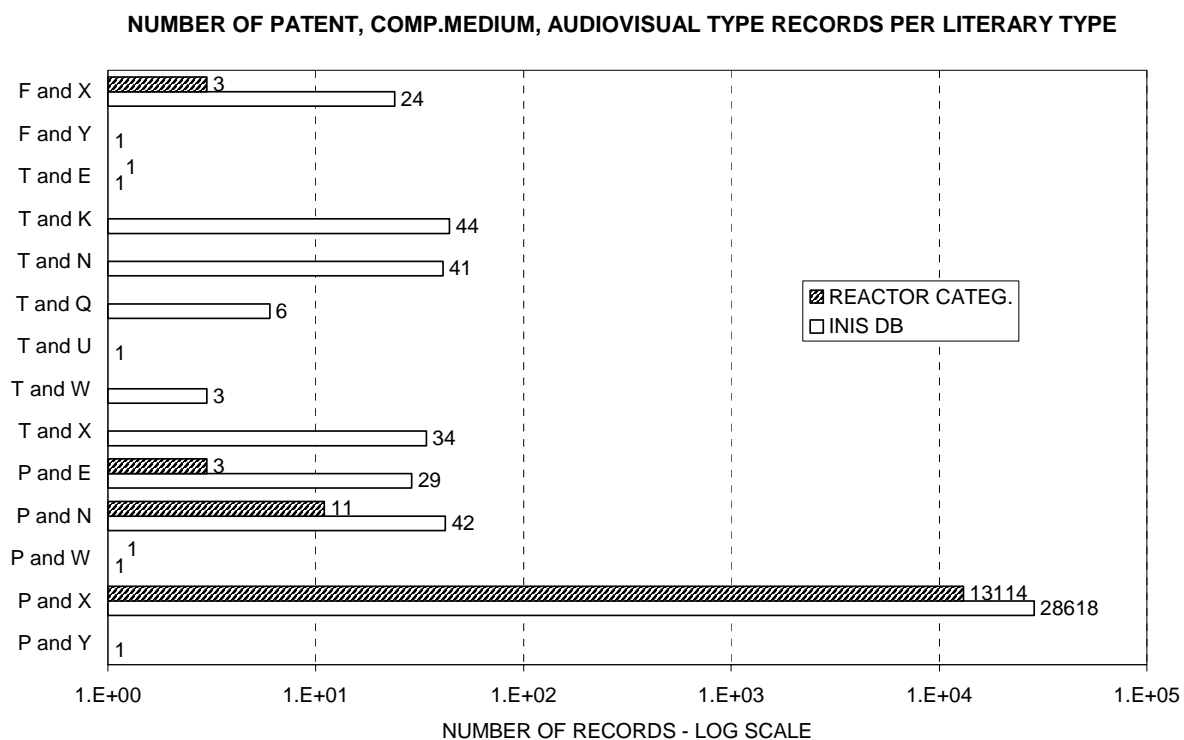


Figure 21



E -	SHORT COMMUNICATION	K -	CONFERENCE	L -	DICTIONARY
N -	NUMERICAL DATA	Q -	LEGISLATION	U -	THESIS
V -	COMPUTER PROGRAM	W -	STANDARD	X -	MICROFICHE-UNAVAILABLE FROM INIS
Y -	PROGRESS-REPORT	Z -	BIBLIOGRAPHY		

Figure 22



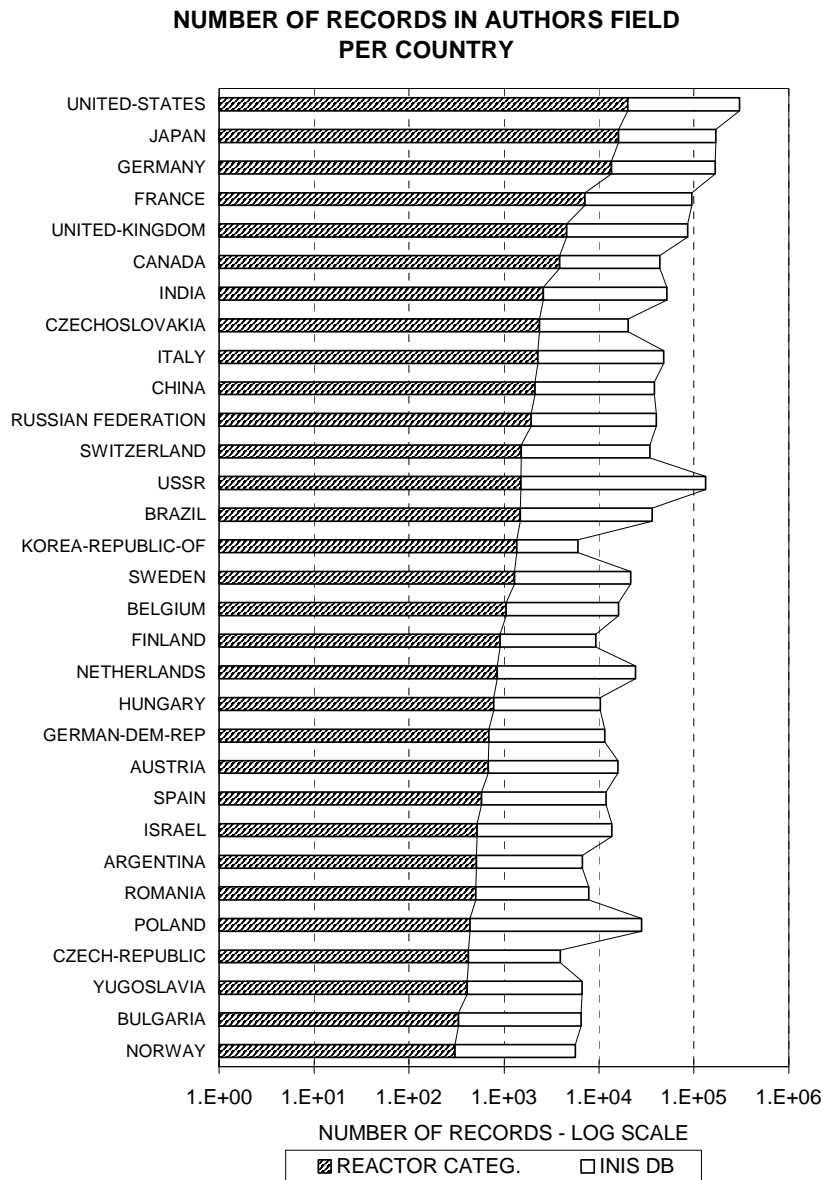
- | | | | | | |
|-----|---------------------|-----|--------------|-----|----------------------------------|
| E - | SHORT COMMUNICATION | K - | CONFERENCE | L - | DICTIONARY |
| N - | NUMERICAL DATA | Q - | LEGISLATION | U - | THESIS |
| V - | COMPUTER PROGRAM | W - | STANDARD | X - | MICROFICHE-UNAVAILABLE FROM INIS |
| Y - | PROGRESS-REPORT | Z - | BIBLIOGRAPHY | | |

Authors, Institutions and Countries

The INIS database also records names of authors, institutions and countries of origin. Names of authors are most commonly specified for journal articles, and books, but exist in many cases for other record types as well. We collected country specific statistics referring to author's countries as well as with respect to corporate entries.

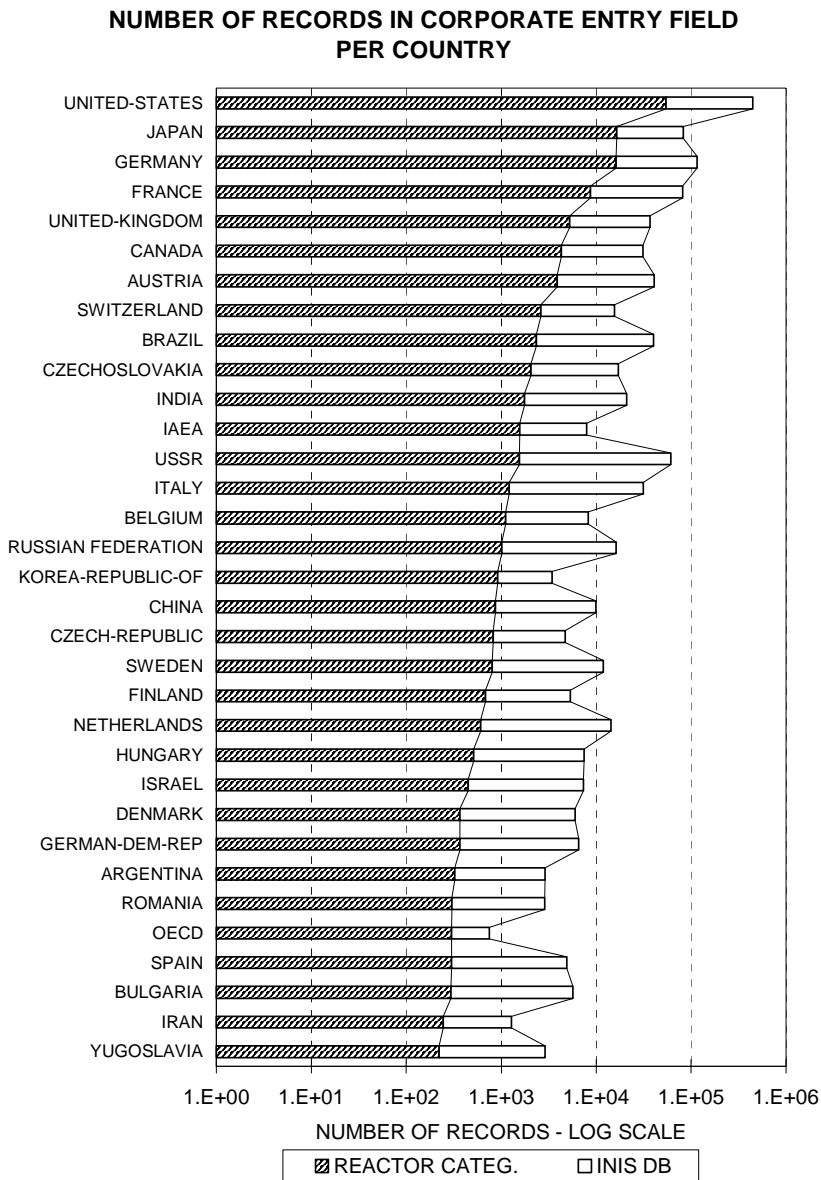
Figure 23 shows the distribution per country of the number of records in fission reactor categories, compared to the respective values in the entire INIS database, using country information from the authors field. Note that this is independent of the country/organization of input.

Figure 23



The country distribution of the number of records in the corporate entry field in fission reactor categories is compared to the respective values in the entire INIS database in Figure 24. These values are again independent of the country/organization of input. Corporate entries include corporate authors i.e. institutions responsible for the scientific content of publications and issuing organizations which are mentioned on the publication technically, editorially or organisationally or are responsible for the content of publication. Examples are academic institutions granting a degree or institutions organizing and/or sponsoring scientific meetings. Corporate author entries include also names of research institutes, laboratories, and names of conferences, meetings, symposia.

Figure 24



More detailed data concerning the distribution of records per country in authors and corporate entry fields are presented in Table 8 with the respective data for records in the INIS Database. The majority of the authors whose publications are present in fission reactor categories come from the USA (21%), Japan (17%), Germany (14%), France (7%), the United Kingdom (5%), Canada (4%), India (3%), Czechoslovakia, Italy, China, the Russian federation, Switzerland, the USSR and Brazil (2%).

The order is changed if the list is ranked according to the appearance of country names in the corporate entry field. It reads: USA (40%), Japan and Germany 12%, France 6%, United Kingdom 4, Canada 3%, Czechoslovakia, Switzerland and Brazil 2%, etc.

We have compared the country entries in author field and in corporate entry field with the country of input. The share of each of the most important countries in the mentioned fields is shown in Figure 25. For most countries the number of records with that country in the corporate entry field is almost the same as in country of input field, and somewhat less than in the authors filed. However, this is not valid for organizations like IAEA, NEA, CEC, or typical inputting countries like the Netherlands.

Figure 25

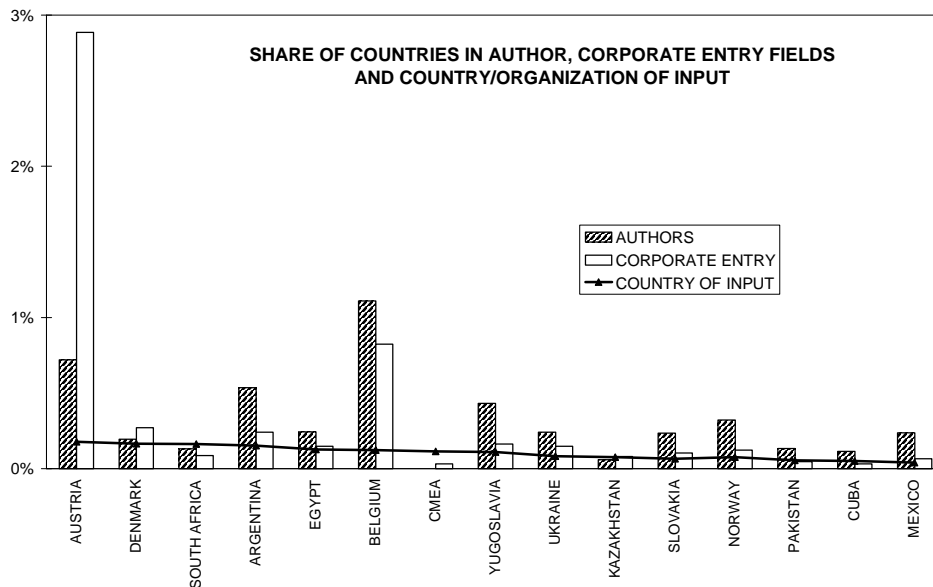
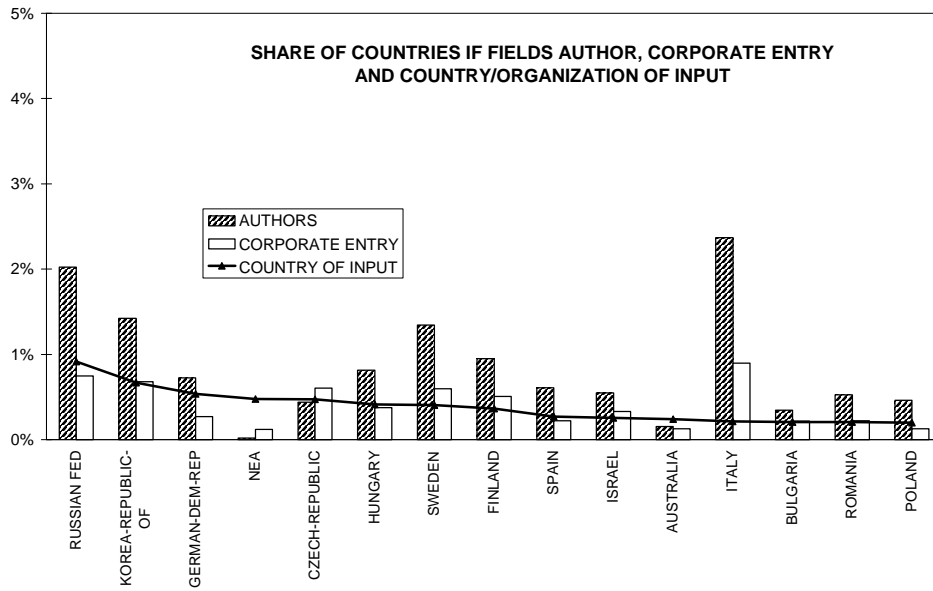
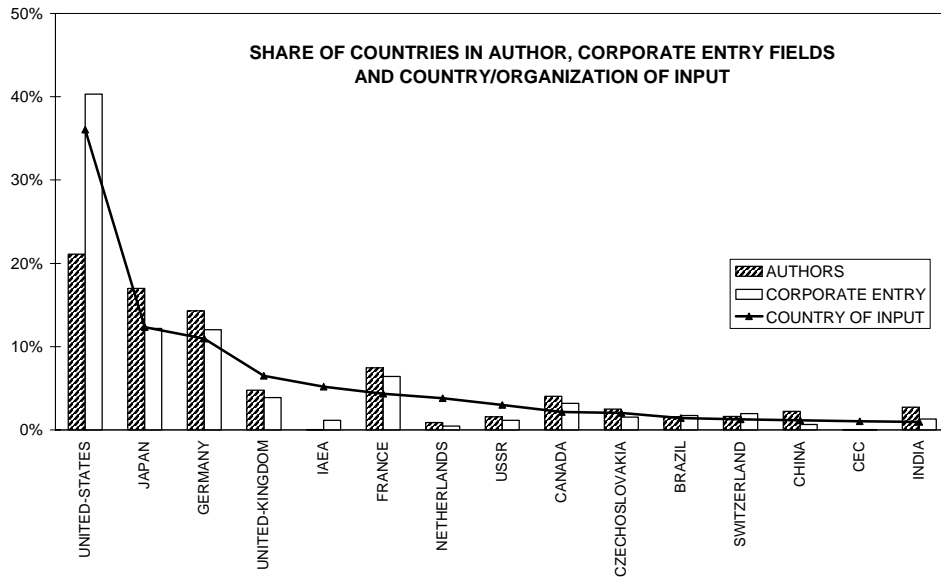


Table 8. Number of records per INIS Member States/organizations in corporate entry and authors field in nuclear reactor categories (C1) and in INIS Database

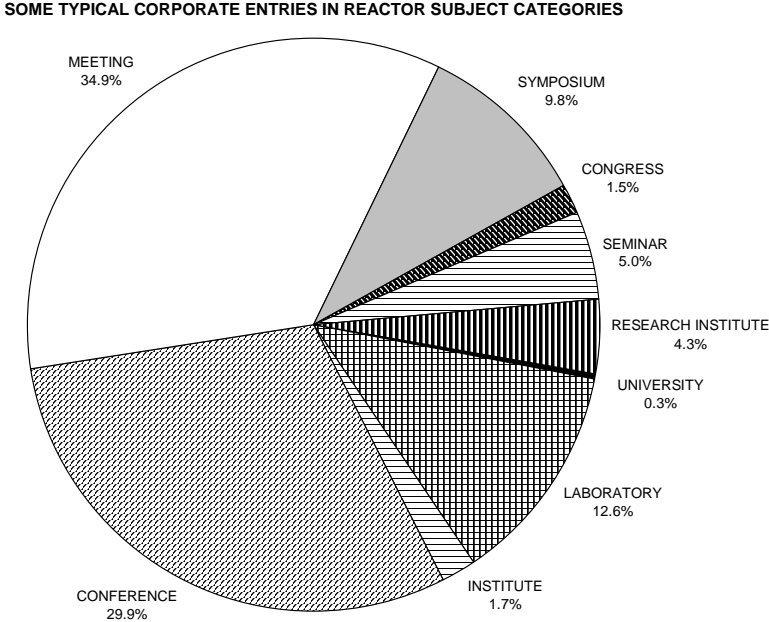
COUNTRY/ ORGANIZATION	AUTHORS				CORPORATE ENTRY			
	REACTOR CATEG.		INIS DB		REACTOR CATEG.		INIS DB	
	No. rec.	(%)	No. rec.	(%)	No. rec.	(%)	No. rec.	(%)
1 UNITED-STATES	20060	21	283207	19	54464	40	391728	36
2 JAPAN	16152	17	155099	10	16470	12	65955	6
3 GERMANY	13610	14	154648	10	16219	12	98923	9
4 FRANCE	7091	7	88522	6	8673	6	73427	7
5 UNITED-KINGDOM	4551	5	81508	5	5261	4	31474	3
6 CANADA	3854	4	39900	3	4289	3	26714	2
7 INDIA	2593	3	49552	3	1763	1	19283	2
8 CZECHOSLOVAKIA	2368	2	18064	1	2060	2	14994	1
9 ITALY	2271	2	45836	3	1214	1	30087	3
10 CHINA	2116	2	36229	2	875	1	9029	1
11 RUSSIAN FEDERATION	1939	2	38534	3	1014	1	15343	1
12 SWITZERLAND	1521	2	32924	2	2630	2	13074	1
13 USSR	1506	2	131199	9	1555	1	59486	6
14 BRAZIL	1497	2	34921	2	2338	2	38210	4
15 KOREA-REPUBLIC-OF	1362	1	4626	0	920	1	2540	0
16 SWEDEN	1287	1	20285	1	809	1	11064	1
17 BELGIUM	1056	1	15139	1	1112	1	7163	1
18 FINLAND	910	1	8389	1	687	1	4698	0
19 NETHERLANDS	850	1	23436	2	608	0	13657	1
20 HUNGARY	779	1	9545	1	510	0	6973	1
21 GERMANY-DEM-REP	694	0	10808	1	365	0	6196	10
22 AUSTRIA	685	1	15165	1	3898	3	36972	3
23 SPAIN	583	1	11359	1	300	0	4579	0
24 ISRAEL	524	1	13257	1	449	0	6866	1
25 ARGENTINA	509	1	6167	0	325	0	2567	0
26 ROMANIA	505	1	7264	0	301	0	2556	0
27 POLAND	441	0	27677	2	171	0	12326	1
28 CZECH-REPUBLIC	422	0	3487	0	820	1	3869	0
29 YUGOSLAVIA	411	0	6251	0	221	0	2687	0
30 BULGARIA	331	0	6164	0	295	0	5396	0
31 NORWAY	306	0	5311	0	167	0	2825	0
32 EGYPT	231	0	4702	0	200	0	2211	0
33 UKRAINE	229	0	9974	1	201	0	5711	1
34 MEXICO	226	0	8591	1	88	0	2034	0
35 SLOVAKIA	223	0	1716	0	139	0	1480	0
36 OECD	202	0	352	0	300	0	448	0
37 DENMARK	185	0	10541	1	365	0	5607	1
38 TURKEY	174	0	2108	0	66	0	1212	0
39 AUSTRALIA	146	0	18973	1	174	0	14040	1
40 SLOVENIA	130	0	657	0	49	0	181	0
41 PAKISTAN	126	0	2740	0	62	0	1169	0
42 SOUTH AFRICA	125	0	7400	0	116	0	4319	0
43 CUBA	108	0	1134	0	44	0	389	0
44 INDONESIA	102	0	1001	0	133	0	747	0
45 GREECE	83	0	3751	0	34	0	1559	0
46 LITHUANIA	67	0	580	0	73	0	362	0
47 IRAN	65	0	1050	0	245	0	1039	0
48 BELARUS	57	0	3150	0	2	0	2080	0
49 KAZAKHSTAN	57	0	1045	0	109	0	1380	0
50 PORTUGAL	48	0	1968	0	125	0	1287	0
51 CEC	40	0	287	0	43	0	231	0
52 CROATIA	38	0	807	0	53	0	438	0
53 BANGLADESH	31	0	702	0	3	0	23	0
54 MALAYSIA	27	0	1315	0	27	0	1178	0
55 SAUDI	26	0	932	0	4	0	28	0
56 CHILE	26	0	1378	0	17	0	246	0
57 IAEA	25	0	505	0	1561	1	6363	1
58 KOREA DEM-REP-OF-	23	0	98	0	0	0	14	0
59 THAILAND	23	0	708	0	15	0	697	0
60 IRELAND	22	0	2702	0	8	0	525	0

Table 8- continued

COUNTRY/ ORGANIZATION	AUTHORS				CORPORATE ENTRY			
	REACTOR CATEG.		INIS DB		REACTOR CATEG.		INIS DB	
	No. rec.	(%)	No. rec.	(%)	No. rec.	(%)	No. rec.	(%)
61 PERU	19	0	309	0	10	0	337	0
62 MACEDONIA	17	0	204	0	10	0	100	0
63 NEA	17	0	120	0	164	0	919	0
64 COLOMBIA	14	0	392	0	0	0	88	0
65 PHILIPPINES	14	0	605	0	11	0	359	0
66 GHANA	12	0	270	0	7	0	92	0
67 ARMENIA	11	0	495	0	1	0	91	0
68 IRAQ	11	0	455	0	13	0	237	0
69 LEBANON	9	0	195	0	1	0	66	0
70 NEW-ZEALAND	7	0	1808	0	2	0	1793	0
71 URUGUAY	7	0	290	0	4	0	78	0
72 SINGAPORE	6	0	385	0	0	0	132	0
73 VENEZUELA	6	0	728	0	4	0	66	0
74 SYRIAN-ARAB-REPUBLIC	5	0	506	0	0	0	30	0
75 ZAIRE	5	0	79	0	0	0	0	0
76 IEA	5	0	56	0	3	0	273	0
77 LIBYAN-ARAB-JAMAHIRIYA	5	0	75	0	6	0	47	0
78 JINR	4	0	461	0	0	0	126	0
79 NIGERIA	4	0	691	0	2	0	119	0
80 GUATEMALA	4	0	92	0	4	0	29	0
81 ALGERIA	4	0	626	0	7	0	153	0
82 MOROCCO	4	0	393	0	31	0	267	0
83 CERN	3	0	4692	0	0	0	486	0
84 QATAR	3	0	50	0	0	0	28	0
85 SRI-LANKA	2	0	159	0	0	0	124	0
86 ESTONIA	2	0	349	0	1	0	235	0
87 MOLDOVA-REPUBLIC-OF	1	0	201	0	0	0	26	0
88 UZBEKISTAN	1	0	1537	0	1	0	1067	0
89 FAO	1	0	338	0	1	0	810	0
90 VIET-NAM	0	0	12	0	0	0	0	0
91 ISO	0	0	0	0	0	0	3	0
92 ICSTI	0	0	0	0	0	0	0	0
93 UN	0	0	0	0	0	0	7	0
94 ALBANIA	0	0	68	0	0	0	0	0
95 BOLIVIA	0	0	70	0	0	0	8	0
96 COSTA-RICA	0	0	3	0	0	0	0	0
97 CTBTO	0	0	11	0	0	0	32	0
98 CYPRUS	0	0	105	0	0	0	95	0
99 DOMINICAN-REPUBLIC	0	0	17	0	0	0	1	0
100 ECUADOR	0	0	102	0	0	0	30	0
101 ETHIOPIA	0	0	45	0	0	0	19	0
102 ICRP	0	0	4	0	0	0	189	0
103 JORDAN	0	0	133	0	0	0	48	0
104 KENYA	0	0	153	0	0	0	123	0
105 MADAGASCAR	0	0	26	0	0	0	0	0
106 MALI	0	0	25	0	0	0	1	0
107 MONGOLIA	0	0	106	0	0	0	39	0
108 MYANMAR	0	0	41	0	0	0	9	0
109 NICARAGUA	0	0	15	0	0	0	12	0
110 PARAGUAY	0	0	48	0	0	0	6	0
111 SUDAN	0	0	408	0	0	0	109	0
112 WHO	0	0	37	0	0	0	174	0
113 ZAMBIA	0	0	68	0	0	0	50	0
114 UNIDO	0	0	4	0	1	0	45	0
115 WEC	0	0	34	0	4	0	43	0
116 AAEA	0	0	1	0	5	0	25	0
117 TUNISIA	0	0	233	0	29	0	176	0
118 CMEA	0	0	0	0	44	0	574	0
TOTAL	95852		1493670		135405		1087655	

Since there are very many different names, only some typical corporate entries in fission reactor subject categories were investigated. From Figure 26 it is evident that the majority of those are related to publications presented at different types of meetings, and only about 20% are related to institutes, laboratories, universities.

Figure 26



Descriptors

Descriptors are scientific and/or technical terms defined in the INIS Thesaurus, which is regularly updated. Each record in the database is indexed by subject specialists, meaning that a number of descriptors is assigned to each record. The use of descriptors is one of the most important tools for Database retrieval.

Since the subject categories concerned with research and technology of fission reactors cover a broad range of problems and since this field is considered to be multidisciplinary, several descriptors are added for describing properly each of the records.

The frequency of appearance of a number of typical descriptors in reactor subject categories and the whole of INIS Database is shown in Table 9. About 51% of the typical descriptors are assigned to records in primary reactor subject categories (C1). This means that reactors are mentioned in other related categories almost as much as in reactor categories, like Fission Nuclear Power Economics (F1100), Nuclear Fuel Cycle Economics (F1200), Social Impact of Nuclear Science and Technology (F13000), Legal Aspects concerned with Radioactive Materials (F2100), Nuclear Installations (F2200), Management and transport of radioactive Materials and Wastes (F2400), Waste Management (E5000), Waste Treatment (E5100), Waste Disposal (E5200), etc.

As expected, the most frequently used descriptor is "REACTORS". It appears 219,910 times in the database and only 59% of these are in the reactor subject categories. The list of 58 different reactor types follows, led by "WATER-COOLED-REACTORS", "POWER-REACTORS", "WATER-MODERATED-REACTORS", "ENRICHED-URANIUM-REACTORS", "THERMAL-REACTORS", etc. Comparison between the occurrence of the mentioned descriptors in the whole database shows that in average, 67% of descriptors appear in the reactor subject categories. A list of specific reactors whose names are present in the Thesaurus would be too long to be presented.

Descriptor "REACTOR ACCIDENTS" appears 48,603 times in the database and only 51% these occurrences are in the reactor subject categories. The occurrence of descriptors concerned with accidents which are typically related to fission reactors is somewhat higher, i.e. 71% in average, showing the importance of accident analysis in the field of nuclear reactors.

The use of descriptors like "REACTOR COMPONENTS", which appears 88,333 times, "REACTOR COOLING SYSTEMS", which appears 24,538 times in the Database, "REACTOR CORES" appearing 18,899 times, "REACTOR MATERIALS" appearing 37,181 times show the importance of each of the related subjects in the field of reactor technology. It is interesting to note that "REACTOR-DCCOMMISSIONING" appears 2,994 times which is about four times as often as "REACTOR COMMISSIONING". The descriptor "REACTOR SAFETY", appears 45,042 times in the Database, and only 62% of this number is in the reactor subject categories showing the importance of this subject for other related fields included in database.

Only about 13% of the occurrences of the descriptor "CALCULATION METHODS" are in the reactor subject categories, but 35% of the occurrences of the descriptor "CODES", and 29% of "COMPUTER CALCULATIONS" occurrences are related to reactor calculation methods. The most frequently used method in the field of fission reactors is the "FINITE-ELEMENT-METHOD", calculations performed are "THREE-DIMENSIONAL-CALCULATIONS", showing that more advanced methods are applied more than the simpler ones as "NEUTRON-DIFFUSION-EQUATION" and "TWO-DIMENSIONAL-CALCULATIONS". "MONTE-CARLO-METHOD" is not frequently applied for fission reactor calculations most probably because it is considered too time consuming.

The descriptor "NUCLEAR POWER PLANTS" appears 53,405 times in the database, and about 47% of this number in reactor subject categories (C1). One should note that related descriptors such as 'PRESSURE VESSELS', STEAM GENERATORS", "POWER GENERATION", "NUCLEAR POWER" do not appear that frequently.

Table 9. Frequency of some typical descriptors appearance in fission reactor subject categories (C1)

No.	DESCRIPTOR	REACTOR CATEG	INIS DB	RATIO
1	REACTORS	130173	219910	59%
2	WATER-COOLED-REACTORS	73628	116973	63%
3	POWER-REACTORS	72845	110606	66%
4	WATER-MODERATED-REACTORS	67407	98461	68%
5	ENRICHED-URANIUM-REACTORS	61483	95583	64%
6	THERMAL-REACTORS	61370	93391	66%
7	PWR-TYPE-REACTORS	45172	65833	69%
8	FAST-REACTORS	24852	36272	69%
9	BWR-TYPE-REACTORS	24319	34838	70%
10	EPITHERMAL-REACTORS	24253	35405	69%
11	BREEDER-REACTORS	20808	30174	69%
12	FBR-TYPE-REACTORS	19481	28018	70%
13	LIQUID-METAL-COOLED-REACTORS	18641	26409	71%
14	RESEARCH-AND-TEST-REACTORS	18433	28279	65%
15	GRAPHITE-MODERATED-REACTORS	13623	28367	48%
16	GAS-COOLED-REACTORS	13004	18419	71%
17	LMFBR-TYPE-REACTORS	12444	17666	70%
18	HEAVY-WATER-MODERATED-REACTORS	9658	14061	69%
19	RESEARCH-REACTORS	9555	15631	61%
20	SODIUM-COOLED-REACTORS	8188	11356	72%
21	WWER-TYPE-REACTORS	7374	9953	74%
22	HEAVY-WATER-COOLED-REACTORS	4718	6907	68%
23	TANK-TYPE-REACTORS	4665	8080	58%
24	IRRADIATION-REACTORS	4355	7763	56%
25	NATURAL-URANIUM-REACTORS	4326	6595	66%
26	HOMOGENEOUS-REACTORS	4079	5464	75%
27	SOLID-HOMOGENEOUS-REACTORS	3501	4642	75%
28	PHWR-TYPE-REACTORS	2820	3901	72%
29	POOL-TYPE-REACTORS	2758	4438	62%
30	ZERO-POWER-REACTORS	2498	3292	76%
31	LWGR-TYPE-REACTORS	2491	12711	20%
32	MOBILE-REACTORS	2113	2515	84%
33	PLUTONIUM-REACTORS	2059	2616	79%
34	SPACE-POWER-REACTORS	2026	2388	85%
35	HYDRIDE-MODERATED-REACTORS	1607	2262	71%
36	TRAINING-REACTORS	1481	2402	62%
37	PRODUCTION-REACTORS	1129	1814	62%
38	PULSED-REACTORS	1084	1837	59%
39	THORIUM-REACTORS	954	1257	76%
40	TRIGA-TYPE-REACTORS	864	1372	63%
41	SPACE-PROPULSION-REACTORS	711	881	81%
42	GCR-TYPE-REACTORS	663	1055	63%
43	SHIP-PROPULSION-REACTORS	622	812	77%
44	MIXED-SPECTRUM-REACTORS	546	913	60%
45	FLUID-FUELED-REACTORS	433	603	72%
46	HWGCR-TYPE-REACTORS	367	645	57%
47	MOLTEN-SALT-REACTORS	363	569	64%
48	WWR-TYPE-REACTORS	347	790	44%
49	SPECIAL-PRODUCTION-REACTORS	338	462	73%
50	ORGANIC-COOLED-REACTORS	212	287	74%
51	METAL-MODERATED-REACTORS	154	227	68%
52	SLOWPOKE-TYPE-REACTORS	123	186	66%
53	ORGANIC-MODERATED-REACTORS	92	126	73%
54	TRANSPORTABLE-REACTORS	57	67	85%
55	WINDSCALE-PRODUCTION-REACTORS	43	121	36%
56	STEAM-COOLED-REACTORS	37	40	93%
57	TRITIUM-PRODUCTION-REACTORS	24	137	18%
58	SGR-TYPE-REACTORS	14	25	56%
59	LWOR-TYPE-REACTORS	4	9	44%

Table 9. - continued

No.	DESCRIPTOR	REACTOR CATEG	INIS DB	RATIO
60	REACTOR-ACCIDENTS	24691	48603	51%
61	LOSS-OF-COOLANT	7979	12446	64%
62	MELTDOWN	3173	5085	62%
63	REACTOR-CORE-DISRUPTION	1900	3255	58%
64	DESIGN-BASIS-ACCIDENTS	1866	2797	67%
65	LOSS-OF-FLOW	1091	1796	61%
66	TRANSIENT-OVERPOWER-ACCIDENTS	396	619	64%
67	EXCURSIONS	389	763	51%
68	ROD-EJECTION-ACCIDENTS	184	227	81%
69	ROD-DROP-ACCIDENTS	183	234	78%
70	REACTOR-CELLS	650	749	87%
71	REACTOR-LATTICES	1873	2111	89%
72	REACTOR-CHANNELS	2655	3427	77%
73	FUEL-CHANNELS	1436	1730	83%
74	EXPERIMENTAL CHANNELS	354	513	69%
75	REACTOR-FUELING	3821	4768	80%
76	REACTOR-CHARGING-MACHINES	856	937	91%
77	REACTOR-DECOMMISSIONING	1616	2994	54%
78	REACTOR-COMMISSIONING	610	785	78%
79	REACTOR-COMPONENTS	64749	88333	73%
80	FUEL-ELEMENTS	18607	27893	67%
81	FUEL-RODS	5944	7737	77%
82	FUEL-PINS	3341	4631	72%
83	FUEL-PLATES	641	777	82%
84	REGULATING RODS	413	452	91%
85	SCRAM-RODS	389	410	95%
86	SHIM RODS	133	143	93%
87	REACTOR-CONTROL-SYSTEMS	8003	8959	89%
88	REACTOR-COOLING-SYSTEMS	19456	24538	79%
89	REACTOR-CORES	16216	18899	86%
90	REACTOR-DISMANTLING	1206	1916	63%
91	REACTOR-EXPERIMENTAL-FACILITIES	344	474	73%
92	REACTOR-MATERIALS	13372	37181	36%
93	REACTOR-OPERATION	12049	17537	69%
94	REACTOR-PROTECTION-SYSTEMS	6388	8473	75%
95	REACTOR-KINETICS	6243	7180	87%
96	REACTOR-MAINTENANCE	4572	6191	74%
97	REACTOR-INSTRUMENTATION	3966	4926	81%
98	ECCS-	3755	5364	70%
99	REACTOR-OPERATORS	3316	4672	71%
100	ENGINEERED SAFETY SYSTEMS	3251	4163	78%
101	REACTOR-MONITORING-SYSTEMS	3030	3440	88%
102	REACTOR-PHYSICS	2306	2812	82%
103	REACTOR-LICENSING	1778	7430	24%
104	REACTOR-NOISE	1769	1909	93%
105	REACTOR-KINETICS-EQUATIONS	839	1001	84%
106	REACTOR-LATTICE-PARAMETERS	651	706	92%
107	REACTOR-CORE-RESTRAINTS	309	349	89%
108	REACTOR-PERIOD	195	217	90%
109	REACTOR-OSCILLATORS	43	50	86%
110	REACTOR-POISON-REMOVAL	34	55	62%
111	REACTOR-SAFETY	27721	45042	62%
112	CONTAINMENT-	9119	15976	57%
113	SAFETY-ENGINEERING	3380	6556	52%
114	CRITICALITY	2924	6881	42%
115	FUEL-ELEMENT-FAILURE	2156	2996	72%
116	SAFETY-STANDARDS	1205	10718	11%
117	SITE-SELECTION	520	8425	6%

Table 9. - continued

No.	DESCRIPTOR	REACTOR CATEG	INIS DB	RATIO
118	REACTOR-SAFETY-EXPERIMENTS	3714	5025	74%
119	REACTOR-SAFETY-FUSES	82	86	95%
120	REACTOR-SHUTDOWN	4124	5386	77%
121	REACTOR-SIMULATORS	2093	2544	82%
122	REACTOR-SITES	974	3989	24%
123	REACTOR-STABILITY	875	930	94%
124	REACTOR-START-UP	1843	2321	79%
125	REACTOR-TECHNOLOGY	901	1556	58%
126	REACTOR-VESSELS	3585	4718	76%
127	NUCLEAR-FUELS	8428	27032	31%
128	FUEL-ASSEMBLIES	11146	14038	79%
129	FUEL-CANS	5340	8442	63%
130	FUEL-CYCLE	4303	12234	35%
131	FUEL-ELEMENT-CLUSTERS	3266	4438	74%
132	FUEL-PELLETS	2887	5569	52%
133	CLADDING-	2875	4331	66%
134	FUEL-MANAGEMENT	2313	3006	77%
135	MIXED-OXIDE-FUELS	2146	3660	59%
136	FUEL-CLADDING-INTERACTIONS	2146	2743	78%
137	FUEL-COOLANT-INTERACTIONS	972	1507	64%
138	FUEL-INTEGRITY	350	424	83%
139	FUEL-ASSEMBLY-DISMANTLING	209	390	54%
140	FUEL-CELLS	98	781	13%
141	FUEL-COOLING-TIME	55	192	29%
142	FUEL-CONSUMPTION	28	446	6%
143	REACTIVITY	8586	10560	81%
144	REACTIVITY-COEFFICIENTS	2707	3406	79%
145	RADIATION-ACCIDENTS	326	5056	6%
146	CRITICAL-MASS	335	591	57%
147	CRITICAL-SIZE	127	279	46%
148	FISSION	11306	56169	20%
149	FISSION-PRODUCTS	4458	13751	32%
150	FISSION-PRODUCT-RELEASE	4225	7701	55%
151	FISSION-NEUTRONS	882	4796	18%
152	FISSION-YIELD	240	2538	9%
153	FISSION-RATIO	153	320	48%
154	FISSION-FRAGMENTS	130	6406	2%
155	FISSION-SPECTRA	91	713	13%
156	FAST-FISSION	76	1040	7%
157	FISSION-POISONS	36	44	82%
158	CONTROL-ELEMENTS	5423	6003	90%
159	CONTROL-EQUIPMENT	5151	11302	46%
160	NEUTRON-ABSORBERS	2372	3211	74%
161	CONTROL-ROD-DRIVES	1986	2133	93%
162	CONTROL-ROD-WORTHS	1182	1232	96%
163	BURNABLE-POISONS	1142	1294	88%
164	NEUTRON-FLUX	7233	14859	49%
165	NEUTRONS	5195	67689	8%
166	NEUTRON-SPECTRA	2010	10291	20%
167	NEUTRON-TRANSPORT-THEORY	1935	4425	44%
168	THERMAL-NEUTRONS	1415	9602	15%
169	NEUTRON-TRANSPORT	1378	4548	30%
170	FAST-NEUTRONS	1300	13597	10%
171	NEUTRON-FLUENCE	1160	6663	17%
172	NEUTRON-REFLECTORS	960	1430	67%
173	NEUTRON-REACTIONS	893	26072	3%
174	FLUX-DENSITY	748	5387	14%
175	NEUTRON-LEAKAGE	449	1049	43%
176	NEUTRON-DENSITY	304	1435	21%
177	PROMPT-NEUTRONS	282	1356	21%
178	EPITHERMAL-NEUTRONS	250	1479	17%

Table 9. - continued

No.	DESCRIPTOR	REACTOR CATEG	INIS DB	RATIO
179	NEUTRON-FLUX-FLATTENING	247	257	96%
180	NEUTRON-ACTIVATION-ANALYSIS	227	9359	2%
181	NEUTRON-IMPORTANCE-FUNCTION	155	229	68%
182	RESONANCE-NEUTRONS	141	937	15%
183	NEUTRON-TEMPERATURE	47	172	27%
184	INTERMEDIATE-NEUTRONS	43	518	8%
185	NEUTRON-AGE	15	52	29%
186	CALCULATION-METHODS	3123	23305	13%
187	CODES	20936	60340	35%
188	COMPUTER-CODES	20787	60005	35%
189	MATHEMATICAL-MODELS	10664	224823	5%
190	NUMERICAL-SOLUTION	7019	40731	17%
191	COMPUTER-CALCULATIONS	6168	21388	29%
192	FINITE-ELEMENT-METHOD	3634	8951	41%
193	CROSS-SECTIONS	3555	115521	3%
194	THREE-DIMENSIONAL-CALCULATIONS	2716	14446	19%
195	NEUTRON-DIFFUSION-EQUATION	1909	2613	73%
196	TWO-DIMENSIONAL-CALCULATIONS	1907	17178	11%
197	MONTE-CARLO-METHOD	1718	23714	7%
198	ITERATIVE-METHODS	1638	7583	22%
199	MULTIPLICATION-FACTORS	1622	2427	67%
200	MULTIGROUP-THEORY	1586	2816	56%
201	ANALYTICAL-SOLUTION	1330	25465	5%
202	BOUNDARY-CONDITIONS	1210	16376	7%
203	ONE-DIMENSIONAL-CALCULATIONS	1053	8431	12%
204	FINITE-DIFFERENCE-METHOD	954	3218	30%
205	GROUP-CONSTANTS	770	1293	60%
206	PERTURBATION-THEORY	753	21503	4%
207	EIGENVALUES-	621	9438	7%
208	BUCKLING	445	626	71%
209	NODAL-EXPANSION-METHOD	353	456	77%
210	BOLTZMANN-EQUATION	299	3268	9%
211	HOMOGENIZATION-METHODS	271	332	82%
212	RESONANCE-ABSORPTION	228	1473	15%
213	ONE-GROUP-THEORY	202	343	59%
214	RESONANCE-INTEGRALS	192	630	30%
215	ALBEDO-	152	1540	10%
216	FOURIER-TRANSFORMATION	147	4296	3%
217	THERMALIZATION-	142	1509	9%
218	NEUTRON-SLOWING-DOWN-THEORY	122	405	30%
219	P1-APPROXIMATION	63	128	49%
220	GALERKIN-PETROV-METHOD	62	295	21%
221	LAGRANGIAN-FUNCTION	61	10506	1%
222	EXTRAPOLATION-LENGTH	37	75	49%
223	BESSEL-FUNCTIONS	37	1333	3%
224	ADJOINT-DIFFERENCE-METHOD	30	74	41%
225	FEYNMAN-METHOD	29	121	24%
226	TRANSFER-MATRIX-METHOD	29	618	5%
227	P3-APPROXIMATION	29	60	48%
228	LAPLACIAN	19	495	4%
229	MILNE-PROBLEM	13	110	12%
230	WIGNER-SEITZ METHOD	13	147	9%
231	P2-APPROXIMATION	6	28	21%
232	BURNUP-	6939	9658	72%
233	ENRICHED-URANIUM	1911	4284	45%
234	URANIUM	73459	186899	39%
235	THORIUM	2463	22675	11%
236	PLUTONIUM	7591	37678	20%

Table 9. - continued

No.	DESCRIPTOR	REACTOR CATEG	INIS DB	RATIO
237	NUCLEAR-POWER-PLANTS	24859	53405	47%
238	PRESSURE-VESSELS	10026	15360	65%
239	STEAM-GENERATORS	9409	12000	78%
240	POWER-GENERATION	2013	8271	24%
241	NUCLEAR-POWER	1481	9194	16%
242	THERMODYNAMICS	2675	11234	24%
245	SOCIO-ECONOMIC-ASPECTS	37	448	8%
246	PUBLIC ANXIETY	22	508	4%
247	PUBLIC INFORMATION	56	740	8%
248	PUBLIC OPINION	541	6418	8%
249	ECONOMICS	3278	16153	20%
250	AVAILABILITY	1832	4369	42%
251	RELIABILITY	8702	17566	50%
252	FAILURES	10015	21651	46%
253	RISK-ASSESSMENT	5918	17798	33%
254	DEFORMATION	5656	30782	18%
255	SAFETY-ANALYSIS	5644	10925	52%
256	SYSTEM-FAILURE-ANALYSIS	3718	6033	62%
257	PROBABILISTIC-ESTIMATION	2832	4751	60%
258	RISK-ANALYSIS	600	4558	13%
259	SAFETY-REPORTS	287	608	47%
260	MAXIMUM-CREDIBLE-ACCIDENT	184	380	48%
261	SAFETY-INJECTION	71	74	96%
262	RADIATION PROTECTION	3525	34901	10%
263	SHIELDING	2338	13308	18%
264	SHIELDS	1242	4242	29%
265	SEISMIC	4832	10602	46%
266	SITE-CHARACTERIZATION	564	4441	13%
267	SEISMICITY-	116	259	45%
268	SITE-PREPARATION	38	156	24%
269	SITE-APPROVALS	19	287	7%
270	AGING	1818	5772	31%

The occurrence of descriptors related to "SOCIO-ECONOMIC-ASPECTS", "PUBLIC ANXIETY", "PUBLIC INFORMATION" and "PUBLIC OPINION" shows that these fields are somewhat neglected when related to fission reactors.

Significant descriptors related to safety like "FAILURES", "RISK-ASSESSMENT", "DEFORMATION", and "SAFETY ANALYSIS", "RADIATION PROTECTION" appear 10,015, 5,918, 5,656, 5,644 and 3,525 times respectively in the reactor subject categories (C1).

Conclusions

Quantitative data obtained in the present analysis show that the share of records concerned with fission reactor related subject categories in the INIS database remained almost constant during the last 25 years (about 8.5%). Most of the publications included in the INIS Database came from countries having highly developed nuclear programs and nuclear power plants in operation, namely the USA, Japan, Germany, the United Kingdom. The main language of publications related to fission reactor subject categories is English (about 67%). Analysis of data by specific reactor subject categories shows that most of the records are related to light water moderated, non-breeding, non-boiling water cooled power reactors.

The distribution of the number of fission reactor related records by record type show that the majority of data, i.e. 32% are journal articles, 31% are report-type, 19% are books. Analysis of the of number of records by literary types shows that the majority of records in fission reactor categories were published as conference publications, (61%).

The time evolution of the number of records in fission reactor subject categories shows that the majority of them was included into the INIS Database in the period from 1985 to 1995, meaning that the activities related to research and technology development in this field were strongest during the mentioned period. This is true for most of the important specific power reactor types, with the exception of breeder reactors. The number of records related to research, test and training reactors is almost constant during that 25 year period.

The frequency of appearance of a number of typical descriptors in reactor subject categories and the whole of INIS Database is analysed. It shows that only 51% of the typical descriptors are assigned to records in primary reactor subject categories (C1). This means that reactors are mentioned in other related categories almost as often as in reactor categories. Related categories include Fission Nuclear Power Economics (F1100), Nuclear Fuel Cycle Economics (F1200), Social Impact of Nuclear Science and Technology (F13000), Legal Aspects concerned with Radioactive Materials (F2100), Nuclear Installations (F2200), Management and Transport of Radioactive Materials and Wastes (F2400), Waste Management (E5000), Waste Treatment (E5100), Waste Disposal (E5200), etc. A more detailed review of appearance of certain significant descriptors in fission reactor subject categories identifies the most important subjects of interest.

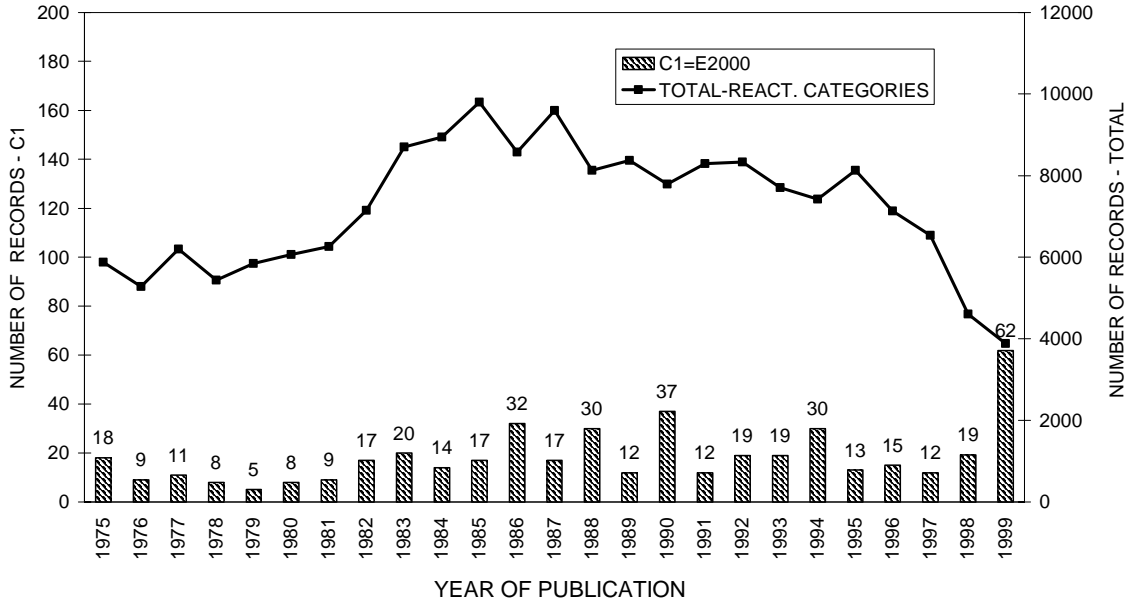
It would be interesting to conduct a similar study in the related subject categories in order to obtain a more complete picture.

References

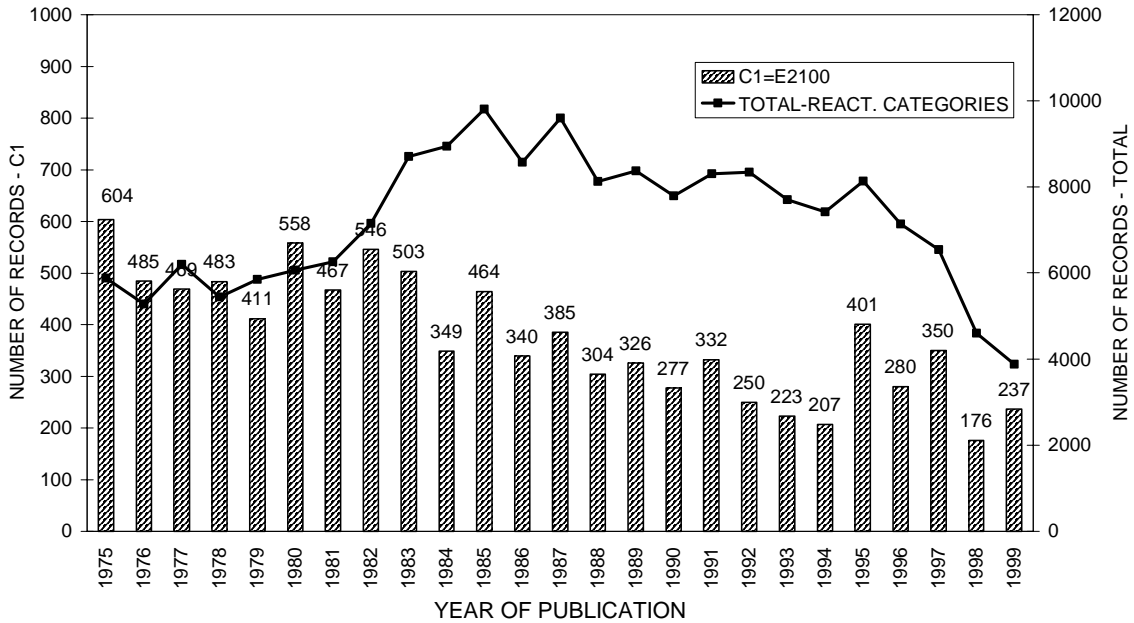
1. INIS: Subject categories and Scope Descriptions, IAEA, Vienna, 1997
2. INIS: Thesaurus, (Rev. 38), IAEA, Vienna, 1999
3. INIS: Authority List for Corporate entries and report Number prefixes, IAEA, Vienna, 1997
4. INIS: Authority List for Journal Titles, IAEA, Vienna, 1999

ANNEX 1. Time dependence of number of input records by reactor type category vs. total number of records in reactor categories

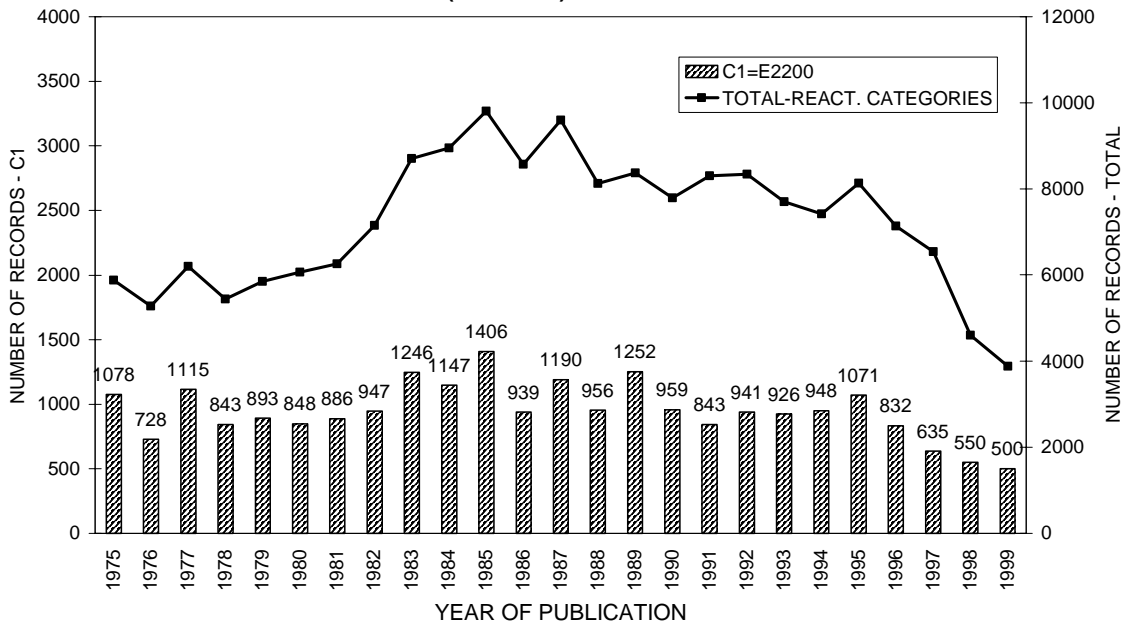
NUMBER OF RECORDS IN SUBJECT CATEGORY "FISSION REACTORS-GENERAL" (C1=E2000) vs. YEAR OF PUBLICATION



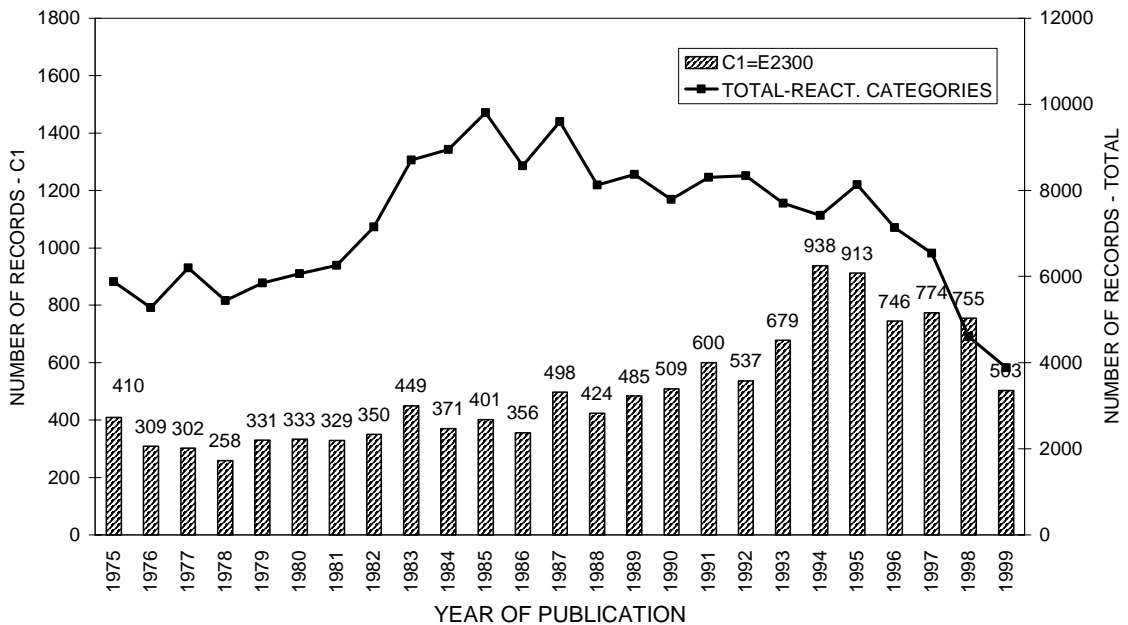
NUMBER OF RECORDS IN SUBJECT CATEGORY "REACTOR THEORY AND CALCULATION" (C1=E2100) vs. YEAR OF PUBLICATION

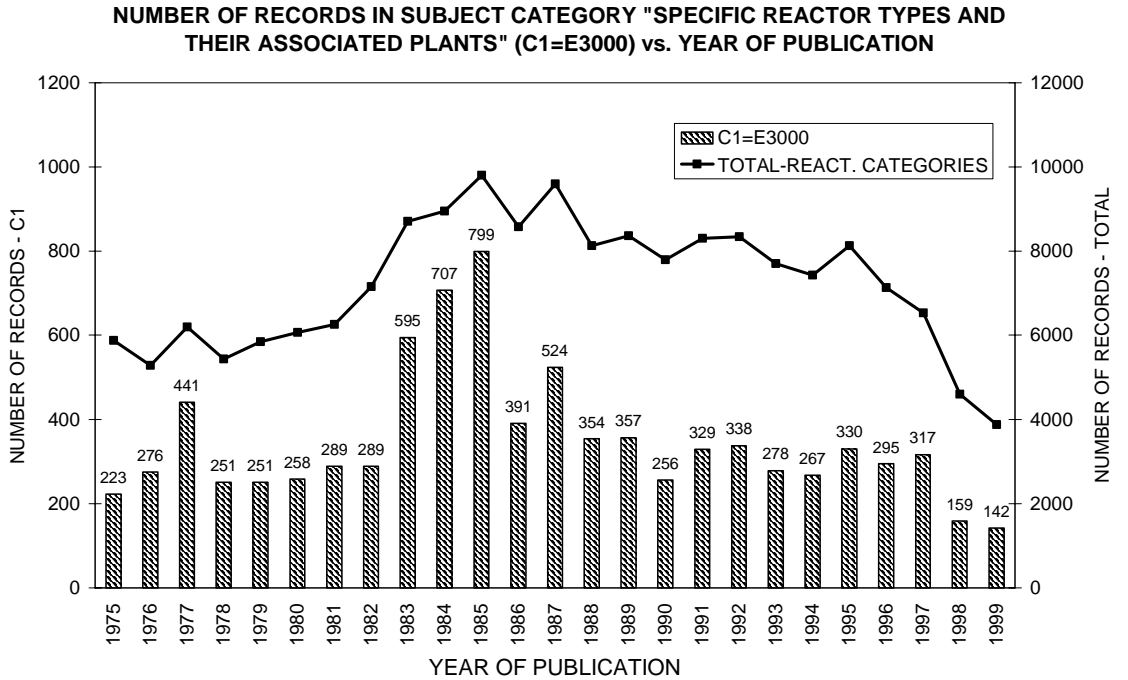
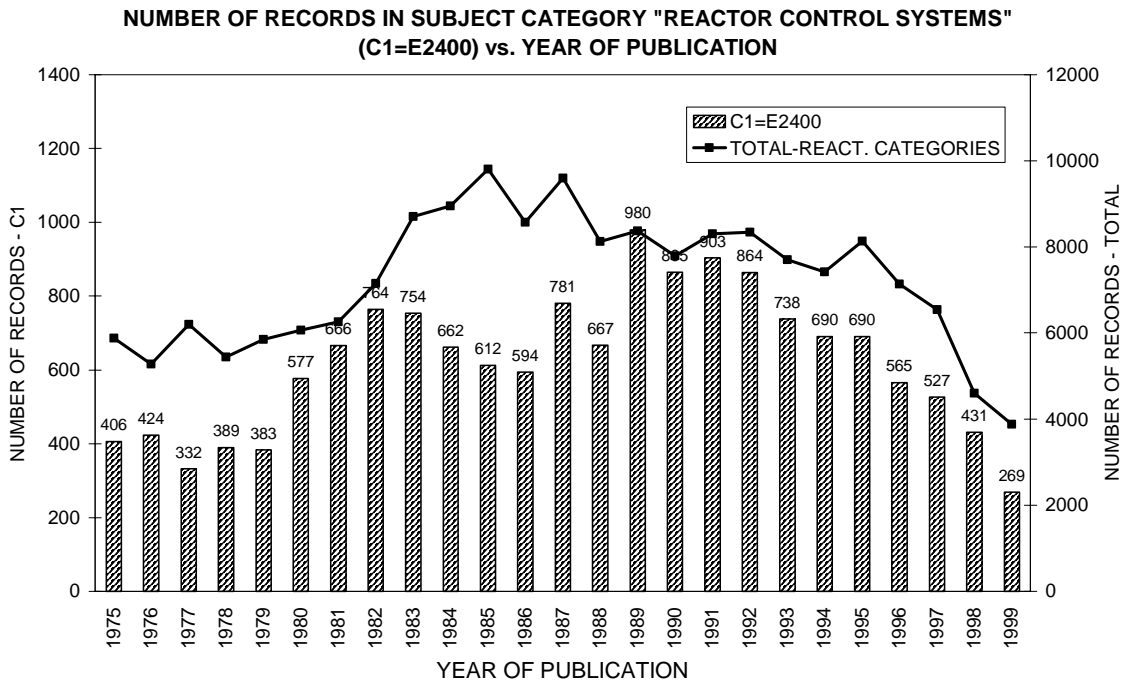


NUMBER OF RECORDS IN SUBJECT CATEGORY "REACTOR COMPONENTS AND ACCESSORIES" (C1=E2200) vs. YEAR OF PUBLICATION

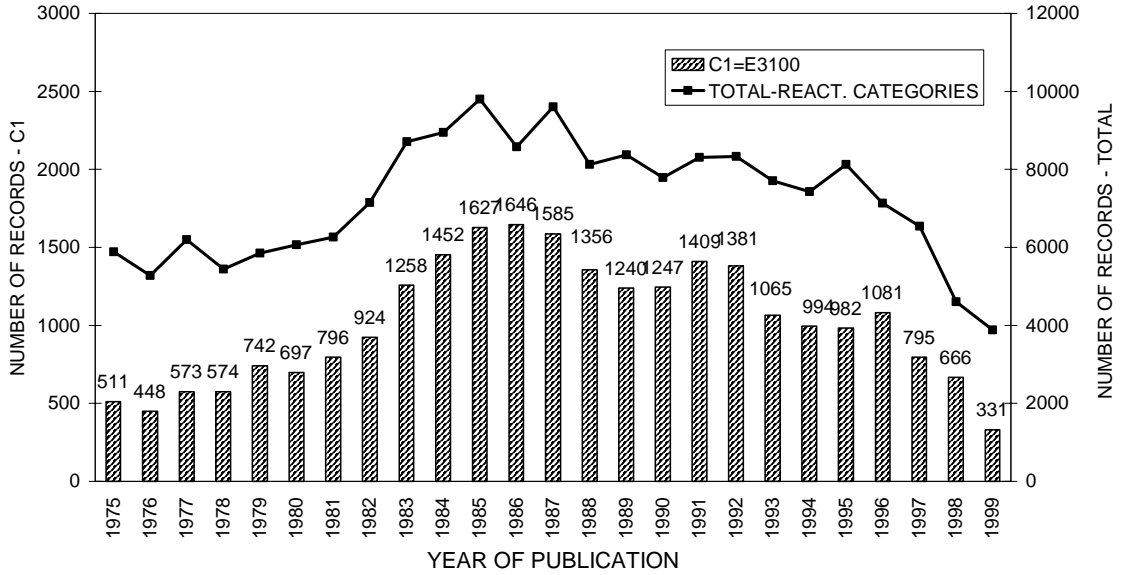


NUMBER OF RECORDS IN SUBJECT CATEGORY "REACTOR FUELS" (C1=E2300) vs. YEAR OF PUBLICATION

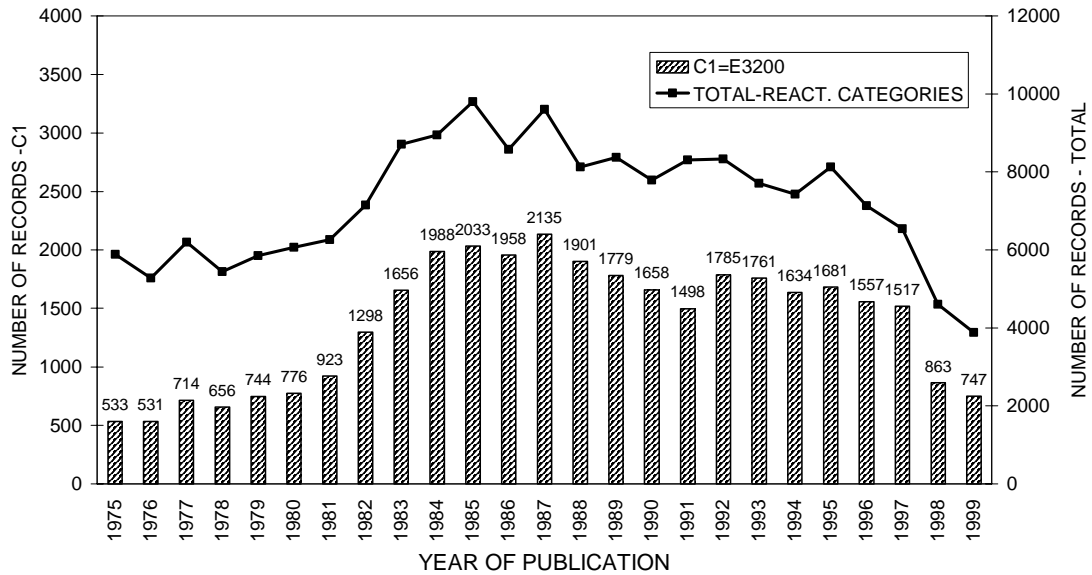




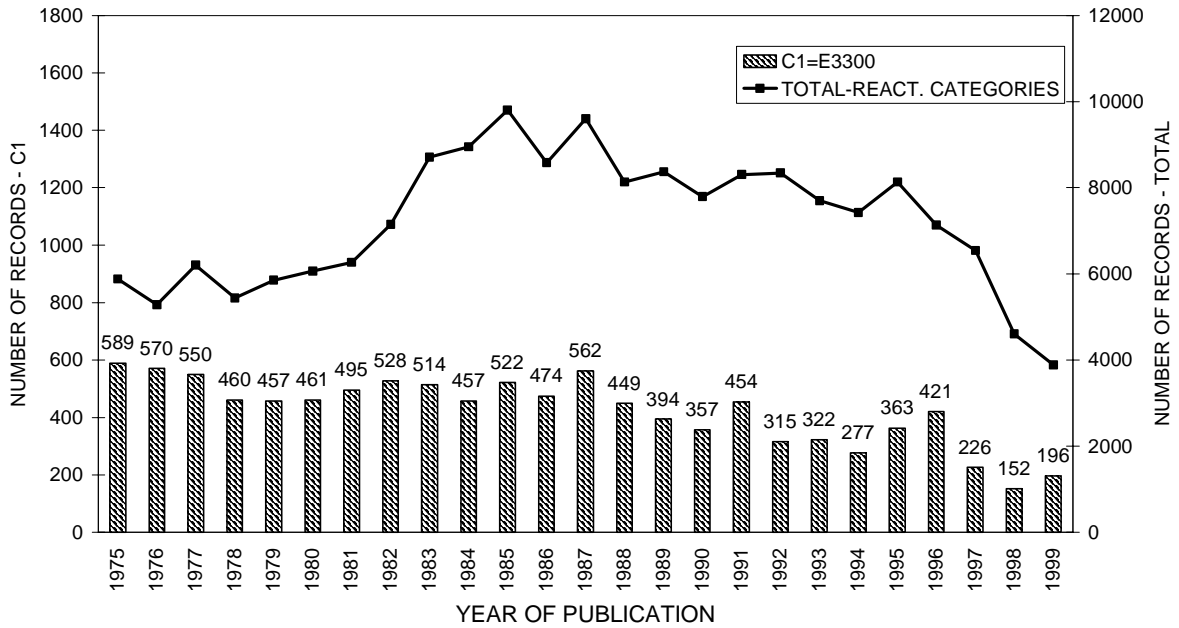
NUMBER OF RECORDS IN SUBJECT CATEGORY "POWER REACTORS, NON-BREEDING, LIGHT WATER MODERATED, BOILING WATER COOLED" (C1=E3100) vs. YEAR OF PUBLICATION



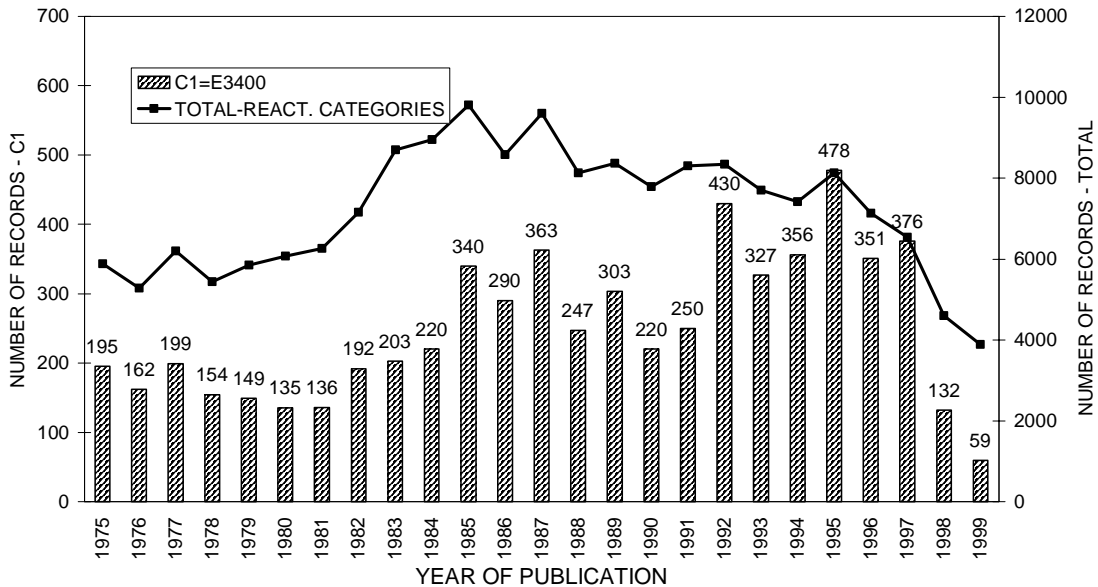
NUMBER OF RECORDS IN SUBJECT CATEGORY "POWER REACTORS, NON-BREEDING, LIGHT WATER MODERATED, NON-BOILING WATER COOLED" (C1=E3200) vs. YEAR OF PUBLICATION



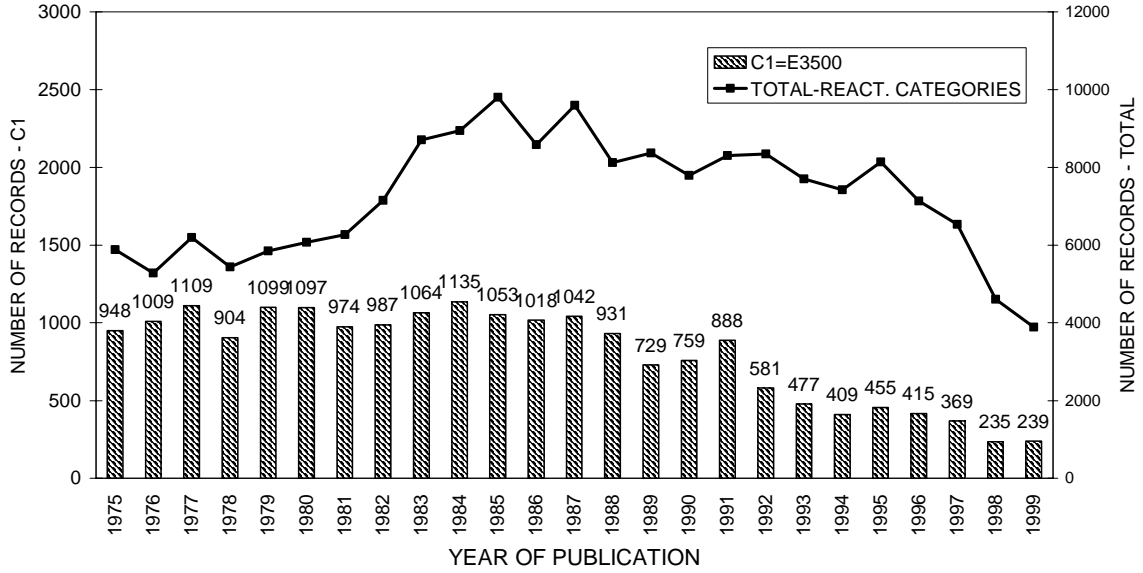
NUMBER OF RECORDS IN SUBJECT CATEGORY "POWER REACTORS, NON-BREEDING, GRAPHITE-MODERATED" (C1=E3300) vs. YEAR OF PUBLICATION



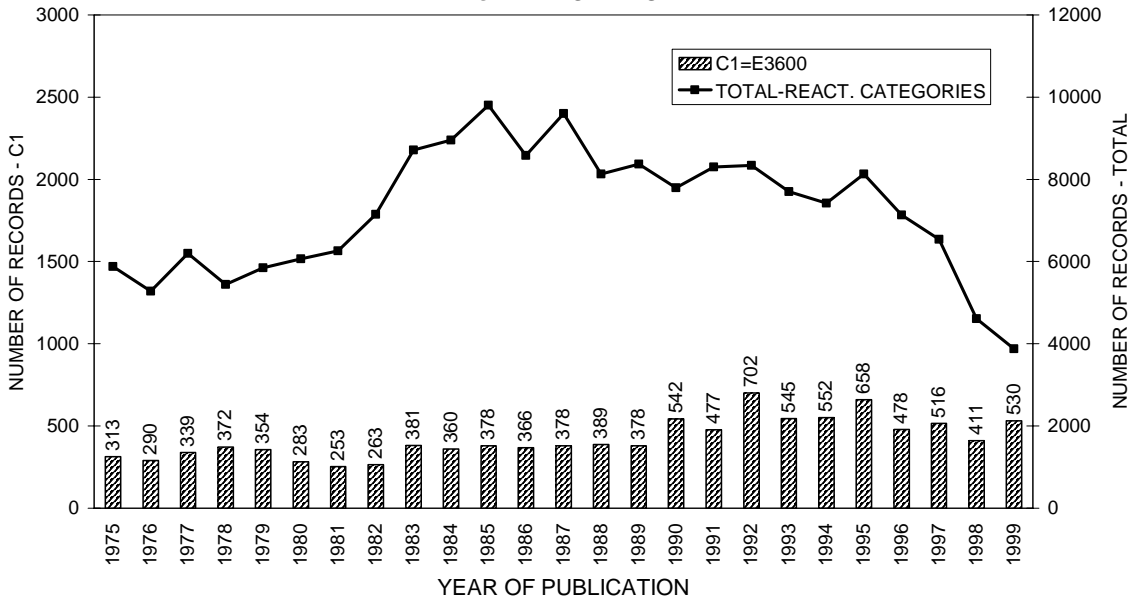
NUMBER OF RECORDS IN SUBJECT CATEGORY "POWER REACTORS, NON-BREEDING, HEAVY WATER OR OTHERWISE MODERATED OR UNMODERATED" (C1=E3400) vs. YEAR OF PUBLICATION



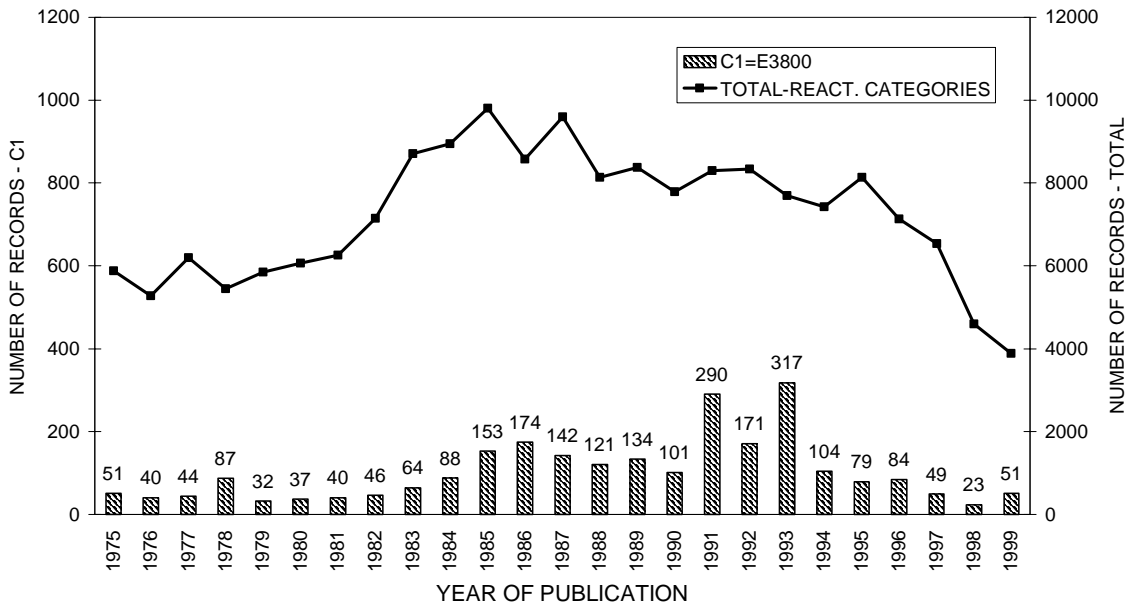
**NUMBER OF RECORDS IN SUBJECT CATEGORY "POWER REACTORS, BREEDING"
(C1=E3500) vs. YEAR OF INPUT**



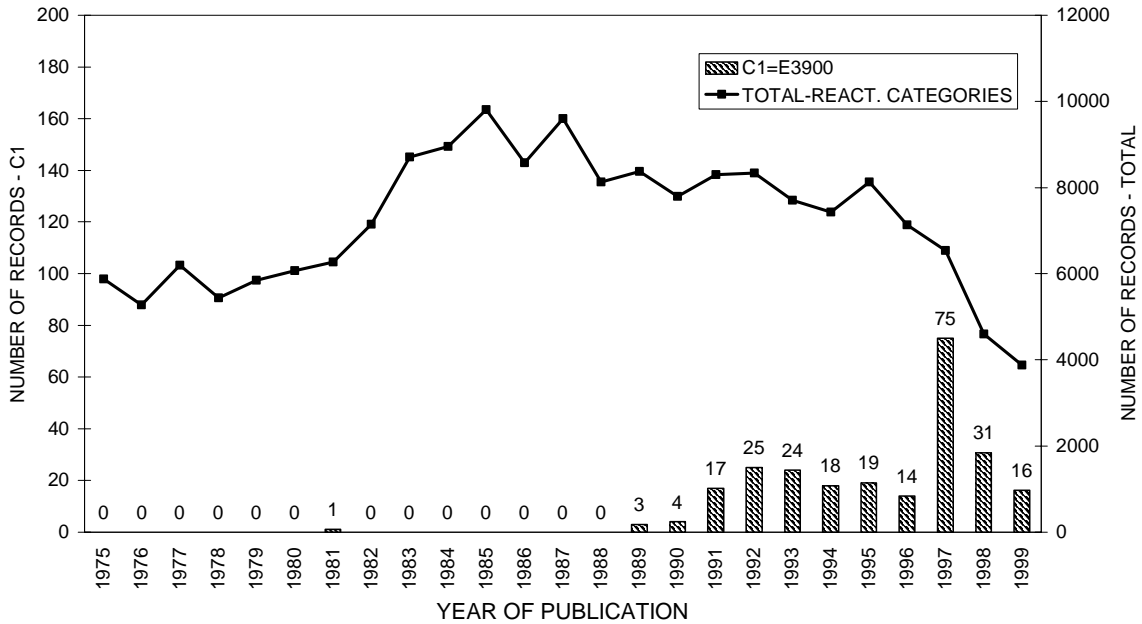
**NUMBER OF RECORDS IN SUBJECT CATEGORY "RESEARCH, TEST, TRAINING,
PRODUCTION, IRRADIATION AND MATERIALS TESTING REACTORS" (C1=E3600)
vs. YEAR OF INPUT**



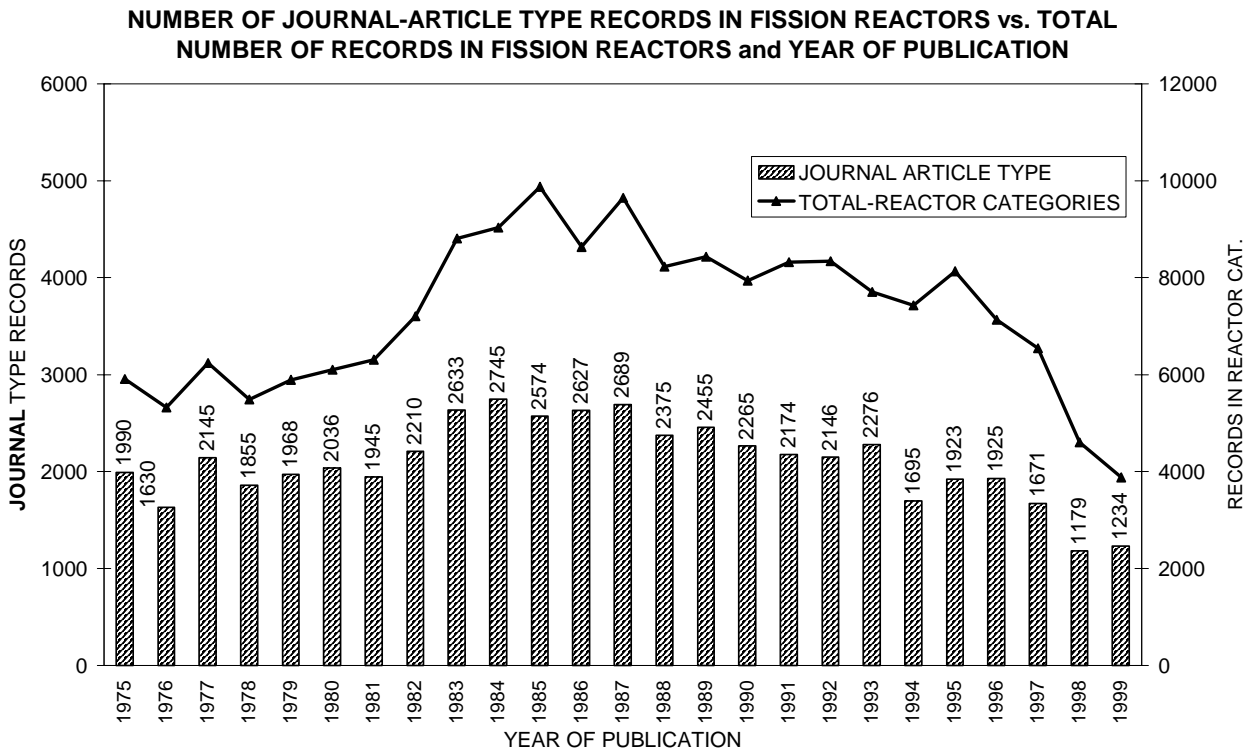
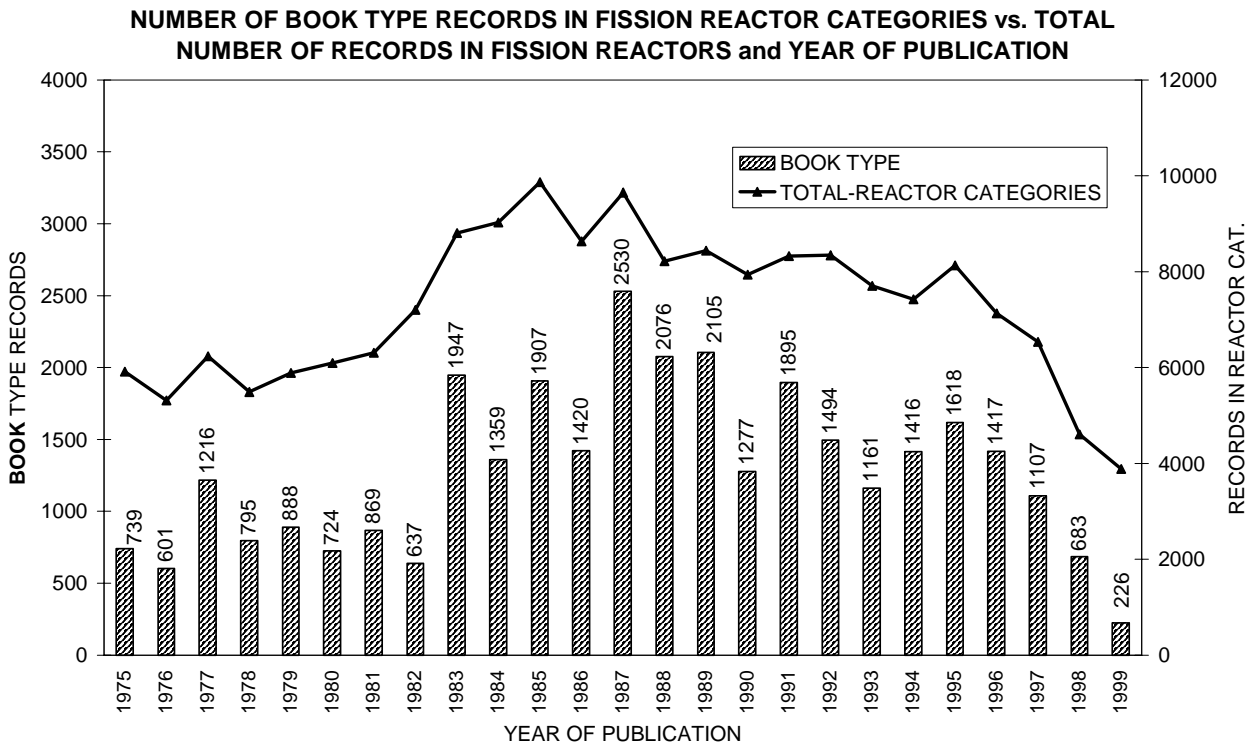
NUMBER OF RECORDS IN SUBJECT CATEGORY "MOBILE, PROPULSION, TRANSPORTABLE AND PACKAGE REACTORS" (C1=E3800) vs. YEAR OF INPUT



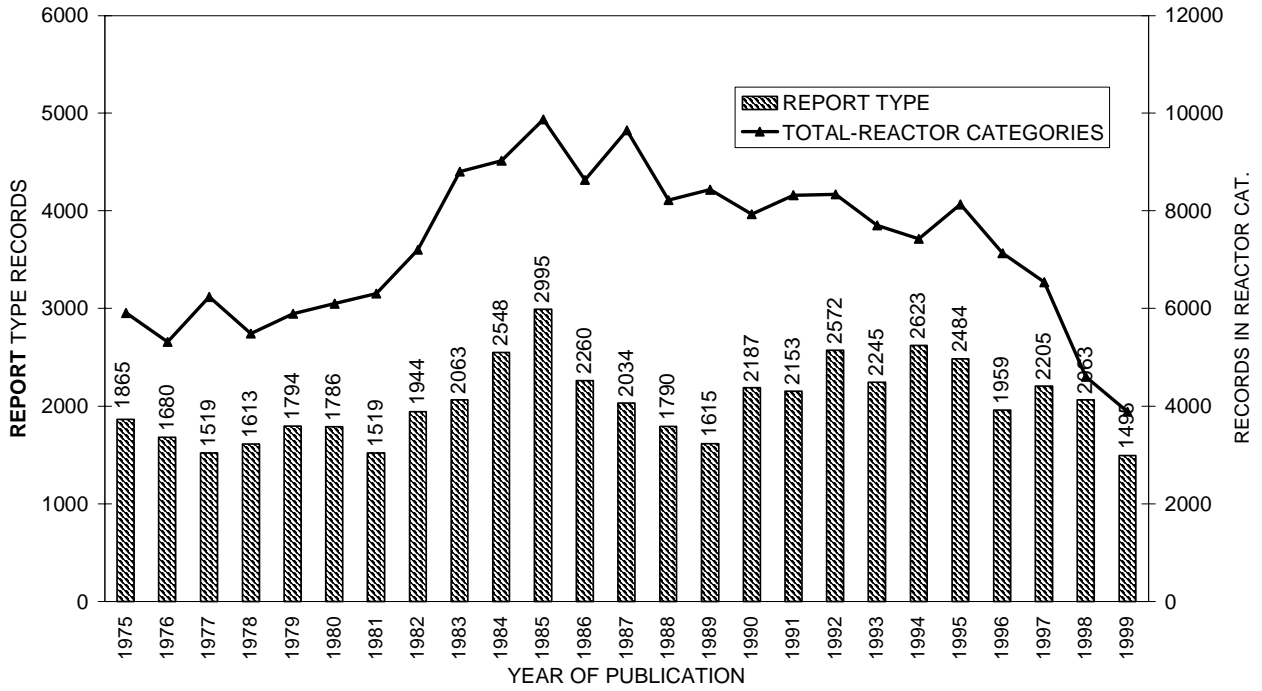
NUMBER OF RECORDS IN SUBJECT CATEGORY "PROCESS HEAT REACTORS" (C1=E3900) vs. YEAR OF INPUT



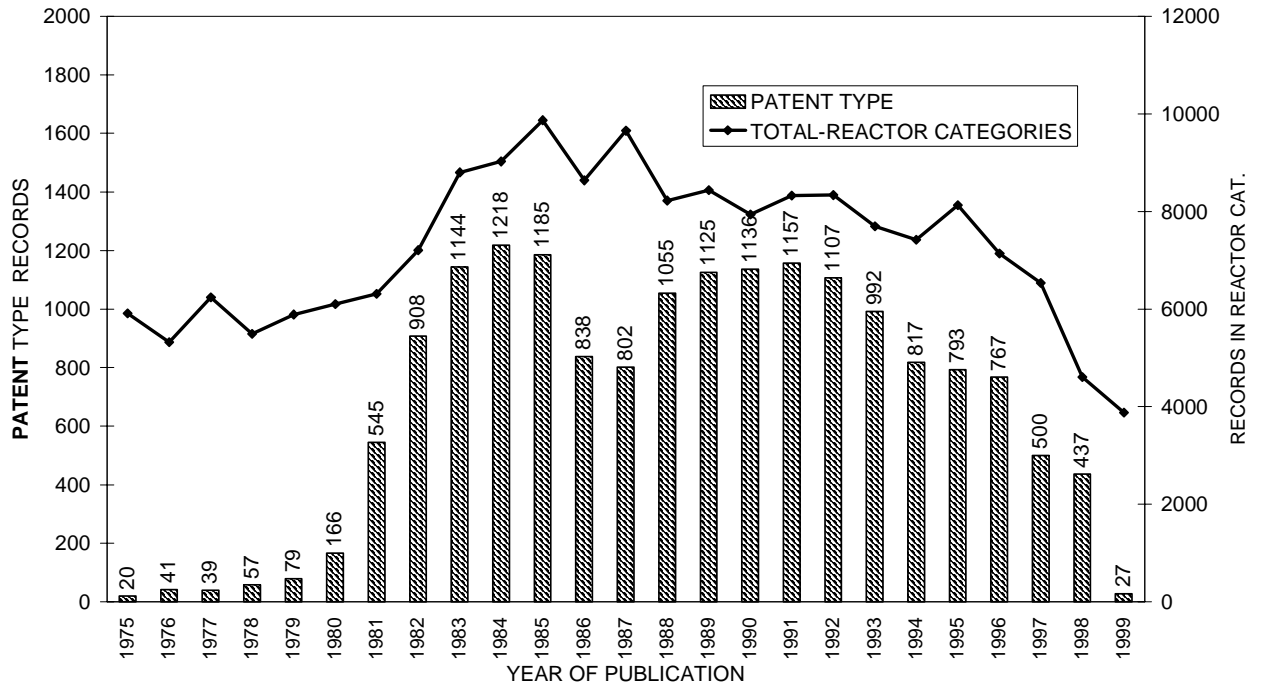
ANNEX 2. Time dependence of input number of records by record type vs. total number of records in reactor categories



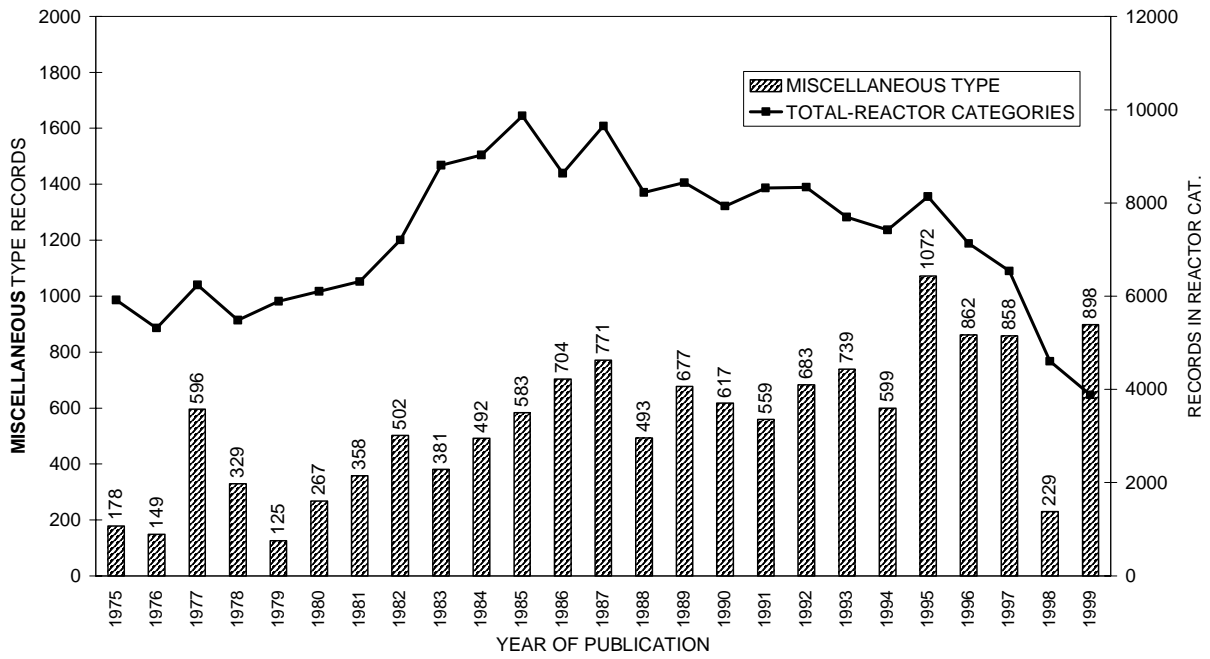
NUMBER OF REPORT TYPE RECORDS IN FISSION REACTOR CATEGORIES vs. TOTAL NUMBER OF RECORDS IN FISSION REACTORS and YEAR OF PUBLICATION



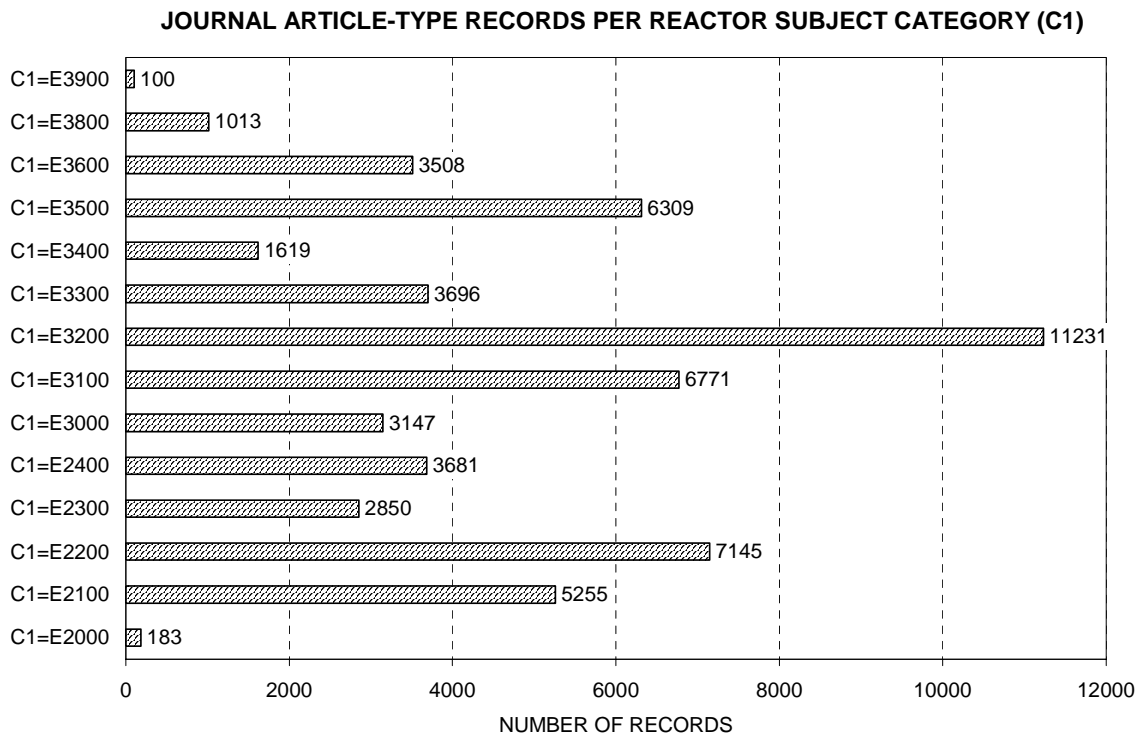
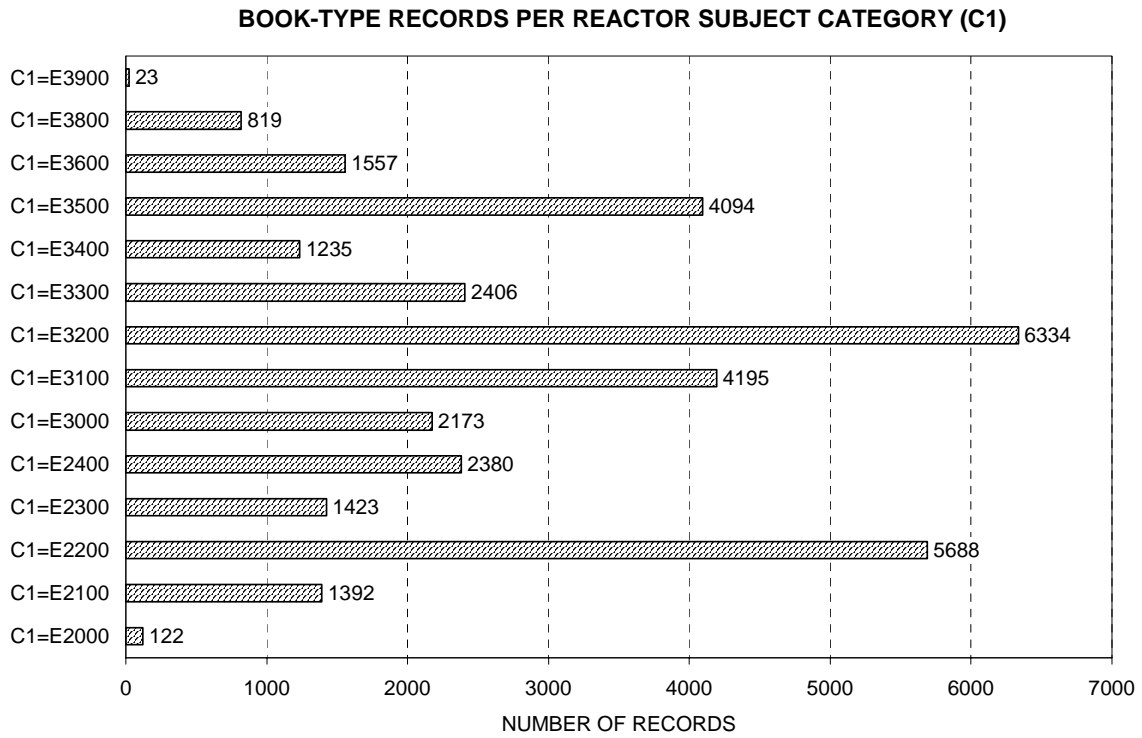
NUMBER OF PATENT TYPE RECORDS IN FISSION REACTOR CATEGORIES vs. TOTAL NUMBER OF RECORDS IN FISSION REACTORS and YEAR OF PUBLICATION



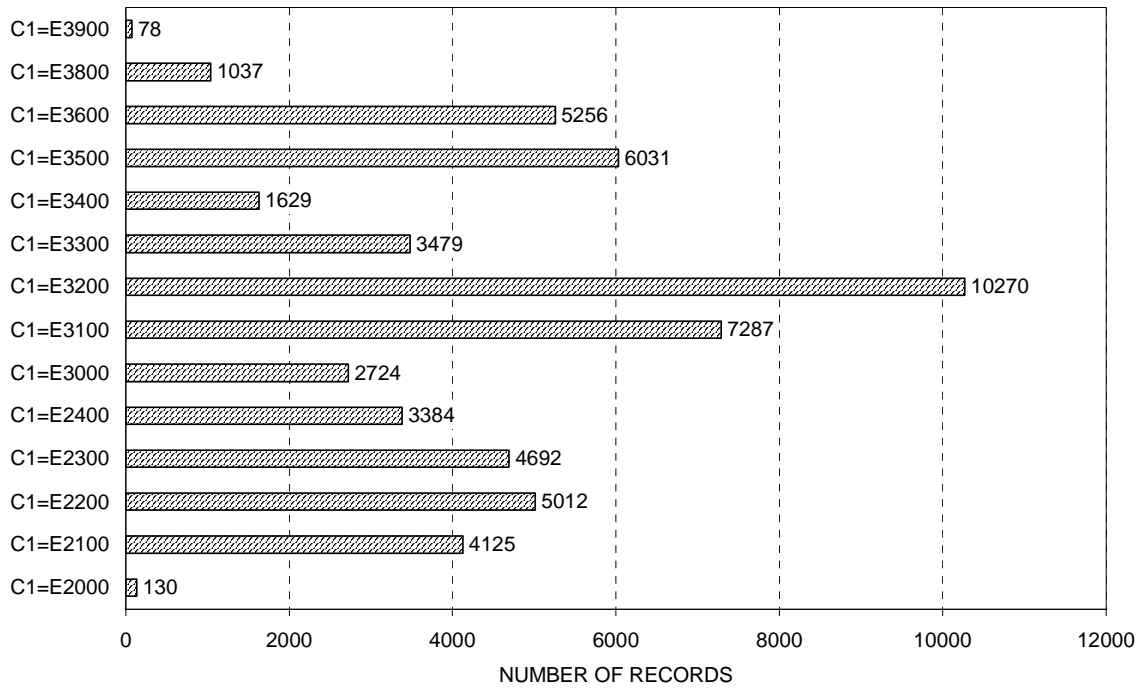
NUMBER OF MISCELLANEOUS TYPE RECORDS IN FISSION REACTOR CATEGORIES vs. TOTAL NUMBER OF RECORDS IN FISSION REACTORS and YEAR OF PUBLICATION



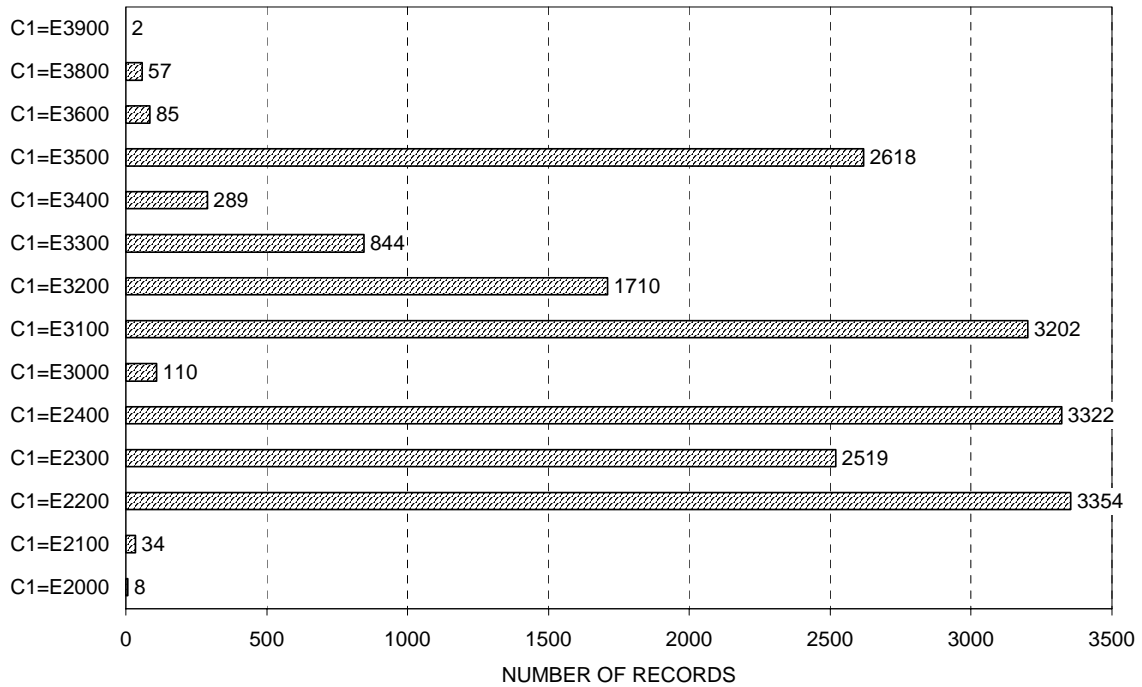
ANNEX 3. Distribution of record types by fission reactor subject categories



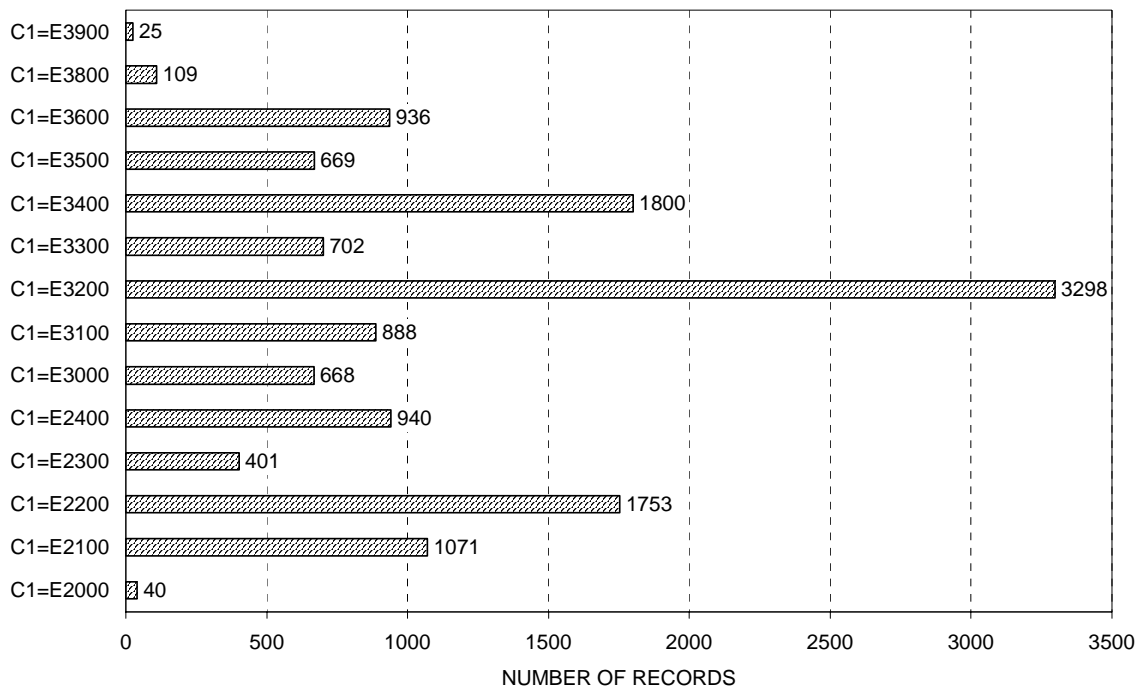
REPORT-TYPE RECORDS PER REACTOR SUBJECT CATEGORY (C1)



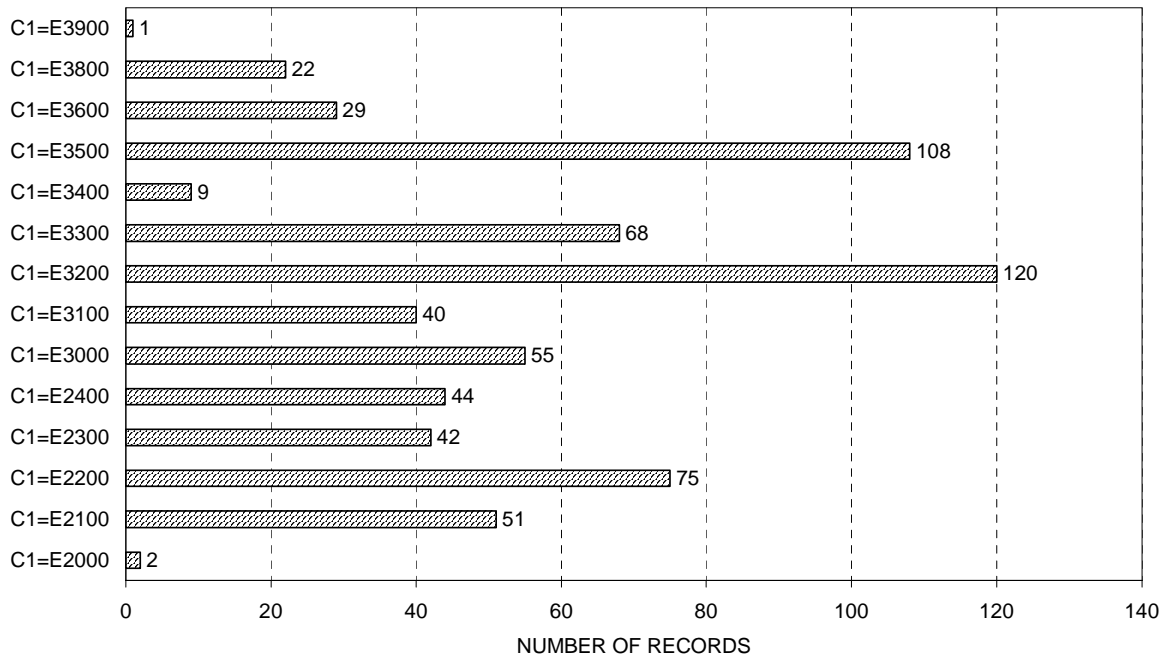
PATENT-TYPE RECORDS PER REACTOR SUBJECT CATEGORY (C1)



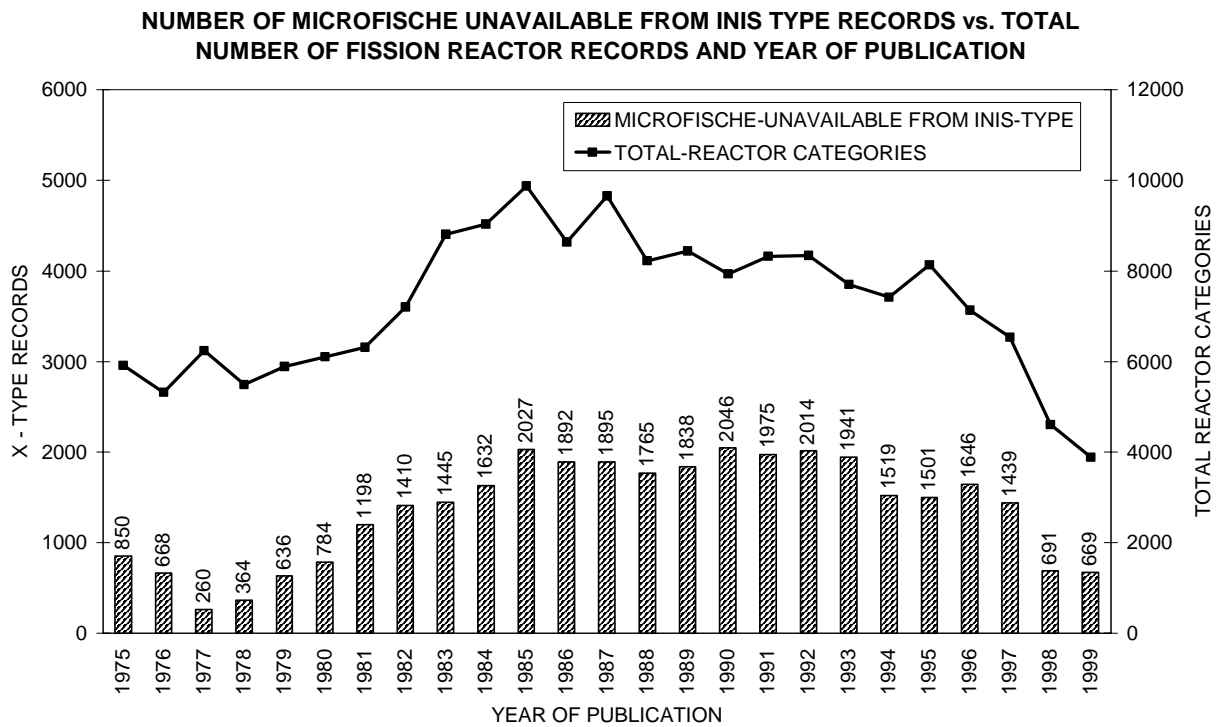
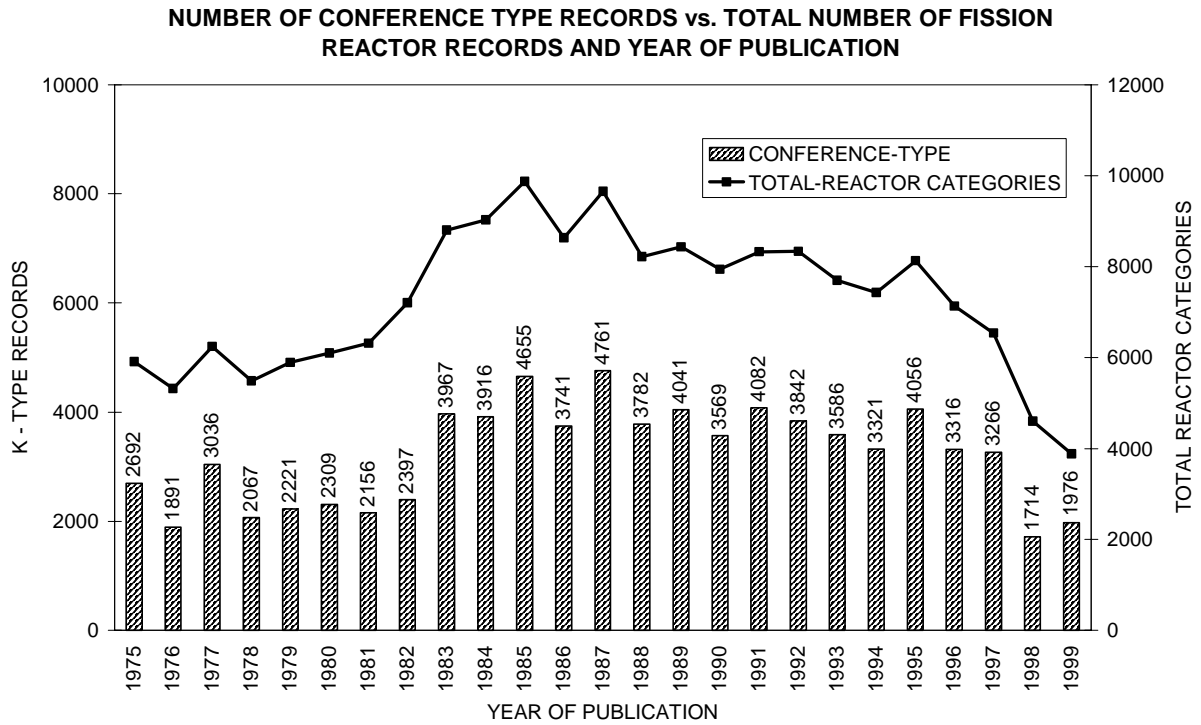
MISCELANEOUS-TYPE RECORDS PER REACTOR SUBJECT CATEGORY (C1)



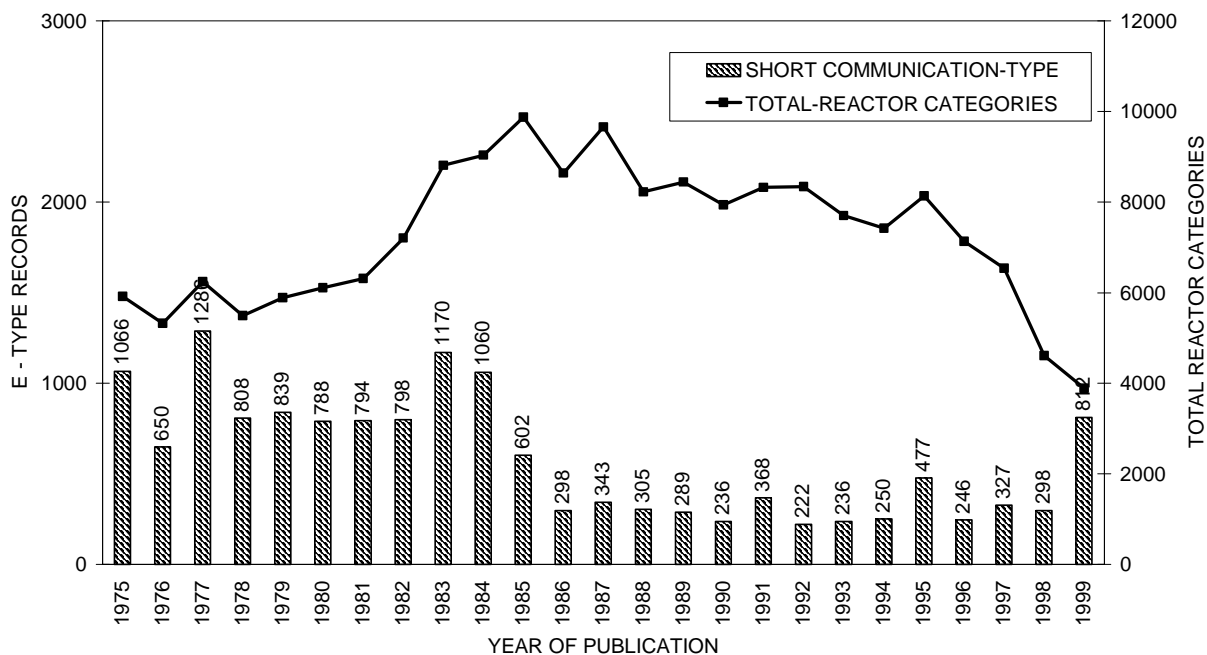
COMPUTER MEDIUM or TRANSLATION-TYPE RECORDS PER REACTOR SUBJECT CATEGORY (C1)



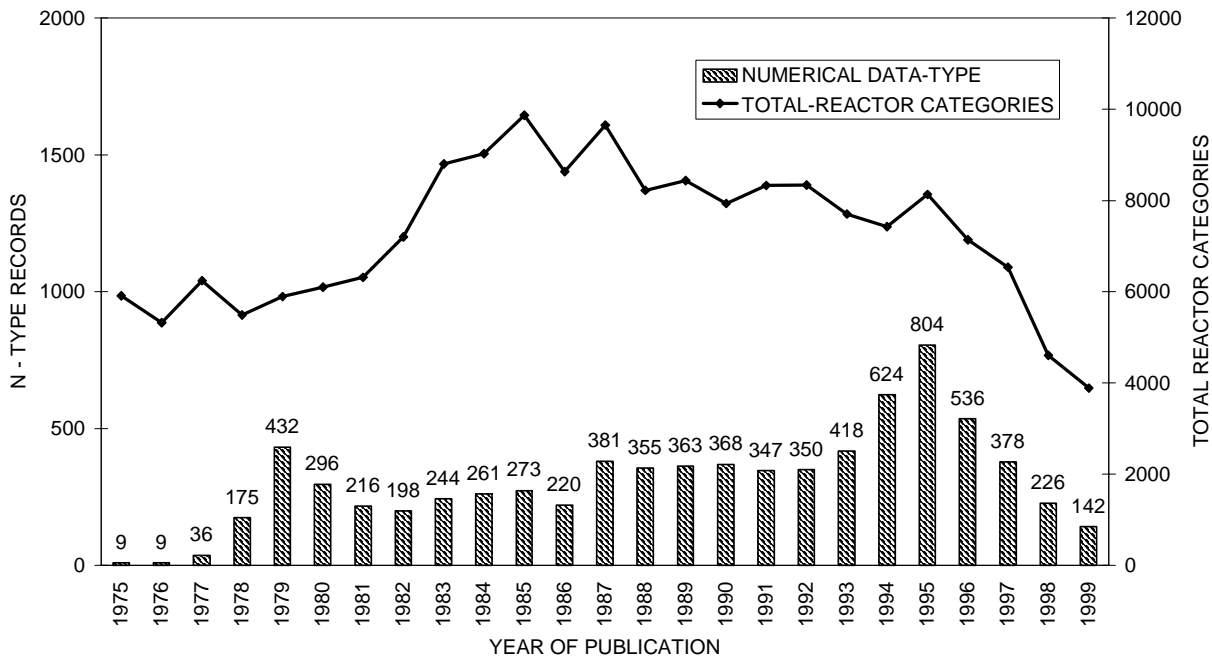
ANNEX 4. Time dependence of number of records in reactor categories per literary type vs. total number of records in reactor categories



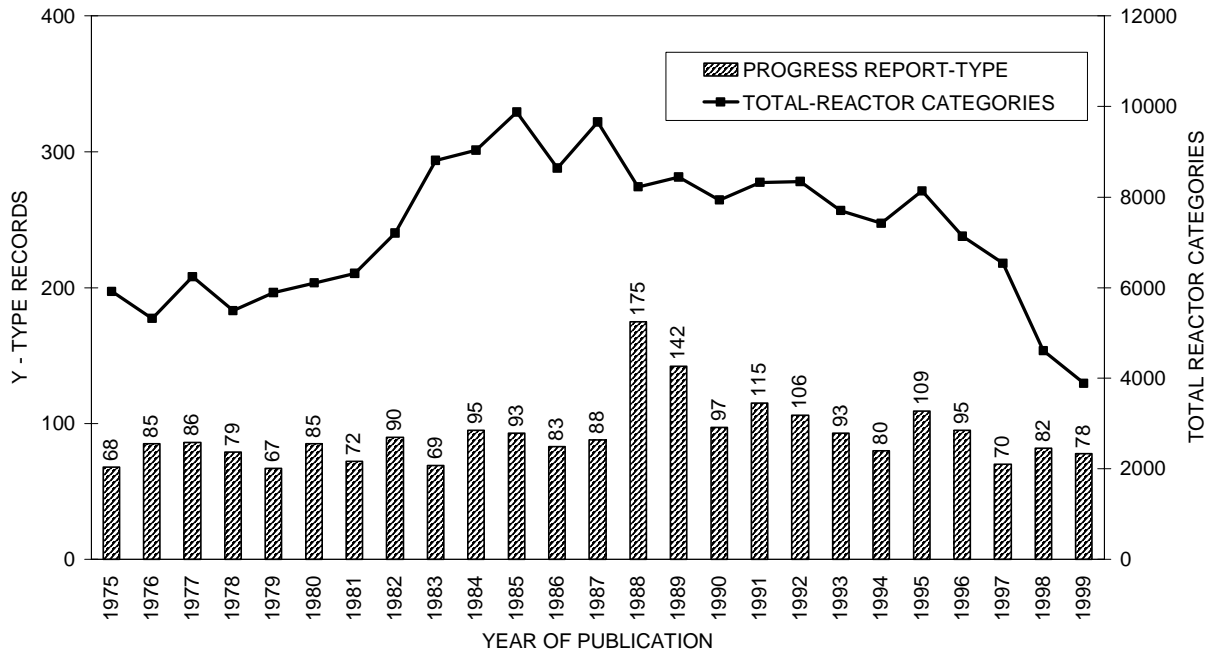
NUMBER OF SHORT COMMUNICATION TYPE RECORDS vs. TOTAL NUMBER OF FISSION REACTOR RECORDS AND YEAR OF PUBLICATION



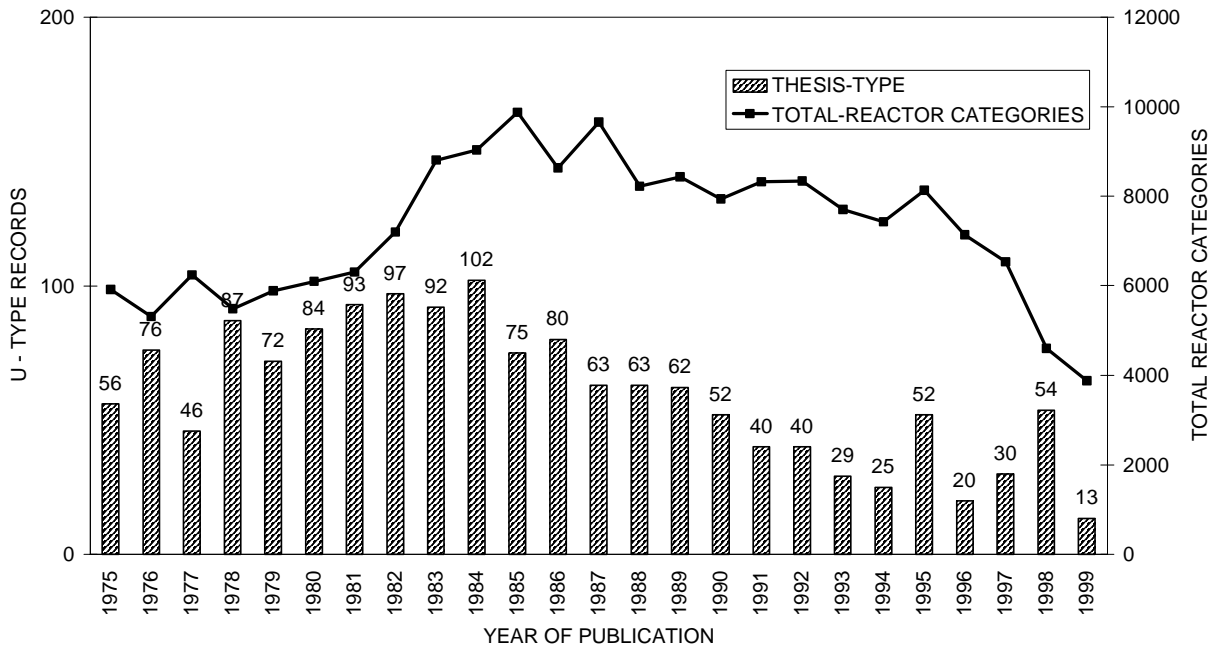
NUMBER OF RECORDS WITH NUMERICAL DATA TYPE vs. TOTAL NUMBER OF FISSION REACTOR RECORDS AND YEAR OF PUBLICATION



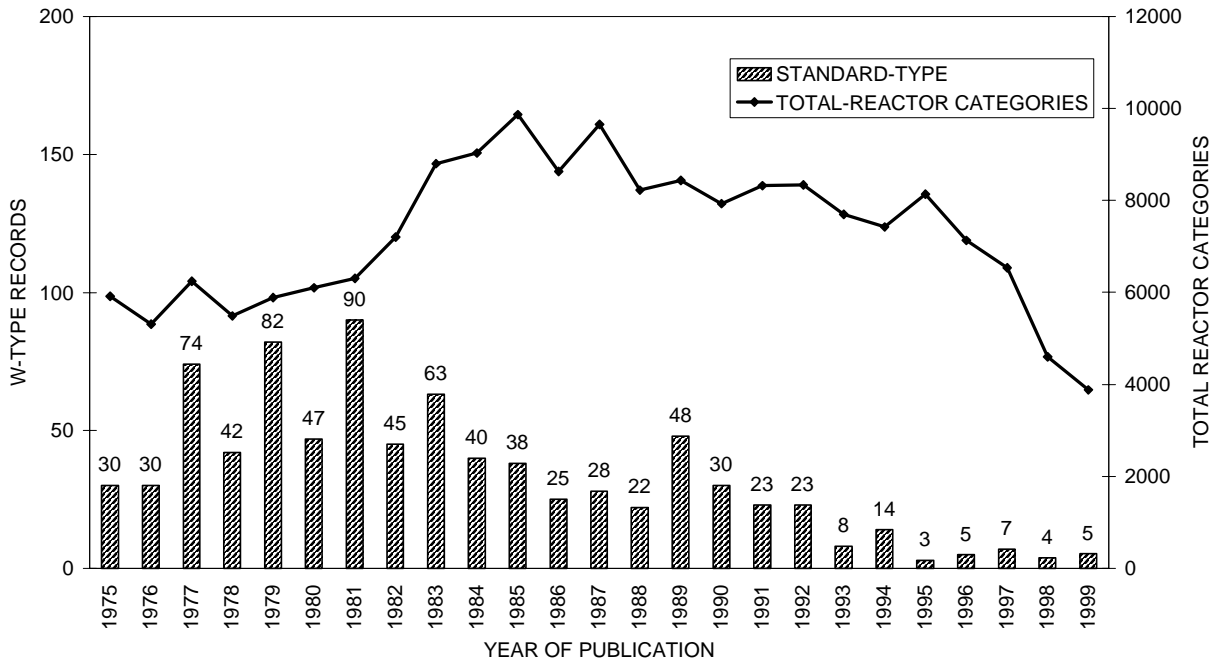
NUMBER OF PROGRESS REPORT TYPE RECORDS vs. TOTAL NUMBER OF FISSION REACTOR RECORDS AND YEAR OF PUBLICATION



NUMBER OF THESIS TYPE RECORDS vs. TOTAL NUMBER OF RECORDS IN REACTOR CATEGORIES AND YEAR OF PUBLICATION



NUMBER OF STANDARD TYPE RECORDS vs. TOTAL NUMBER OF FISSION REACTOR RECORDS AND YEAR OF PUBLICATION



NUMBER OF COMPUTER PROGRAM TYPE RECORDS vs. TOTAL NUMBER OF FISSION REACTOR RECORDS AND YEAR OF PUBLICATION

