

# **RESEARCH REACTOR RECORDS IN THE INIS DATABASE**

## **- A Bibliometric Study -**

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March 2002

### **Abstract**

This report presents a statistical analysis of more than 13,000 records of publications concerned with research and technology in the field of research and/or experimental reactors which are included in the INIS Bibliographic Database for the period from 1970 to 2001. The main objectives of this bibliometric study were: to make an inventory of research reactor related records in the INIS Database; to provide statistics and scientific indicators for the INIS users, namely science managers, researchers, engineers, operators, scientific editors and publishers, decision-makers in the field of research reactors related subjects; to extract other useful information from the INIS Bibliographic Database about articles published in research reactors research and technology.

The quantitative data in this report are obtained for various properties of relevant INIS records such as year of publication, secondary subject categories, countries of publication, language, publication types, literary types, etc.

## Records related to Research Reactors in the INIS Database

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

- reactor theory, reactor physics calculation, in-pile experiments verifying reactor theory and calculations, computations of in-reactor processes;
- 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;
- design, fabrication and performance of fuel pellets, fuel elements and fuel assemblies, fuel loading procedures;
- fuel fabrication plants (regardless of the type of fuel elements produced), including technical aspects of safety, decommissioning and dismantling;
- 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;
- elements of reactor and nuclear power plants control systems, including drive units, control rods, safety rods and incorporated instrumentation;
- reactor and reactor plant computerised control systems;
- man-machine interaction problems in reactor control;
- technical aspects of safety;
- 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;
- real accidents

Each record in the INIS Database is assigned a primary subject category (C1). According to the above mentioned fields of interest records related to fission reactors research and technology in INIS Database are assigned a specific subject category.

This analysis deals with records in the Research, Test, Training, Production, Irradiation and Materials Testing Reactors, category (E3600) and covers the period from 1970 till the end of 1999. It includes all items which have been published and input into the INIS Database till the end of 1999. The INIS Database is published on CD-ROM by the INIS Secretariat. It comprises seven archival discs covering the period from 1970 through 2000 and one current disc. The last CD taken into account for the present analysis was labelled "2001/01-2001/12". In January 2000 the old INIS subject categories have been replaced by a new common INIS and ETDE subject categorization scheme. Records related to research reactors submitted to the INIS Database after the end of 1999 are taken into account by a separate search performed according to the new subject category scheme (categories S21 and S22). Since the new categories cover a much broader field of interest the searches were narrowed by applying descriptors "EXPERIMENTAL-REACTORS", "RESEARCH-AND-TEST-REACTORS", "ZERO-POWER-REACTORS", "RESEARCH-REACTORS".

In time dependence analysis, records published before 1975 were not included, since records collected during the start-up period of the INIS Database from 1970-1974, suffer from

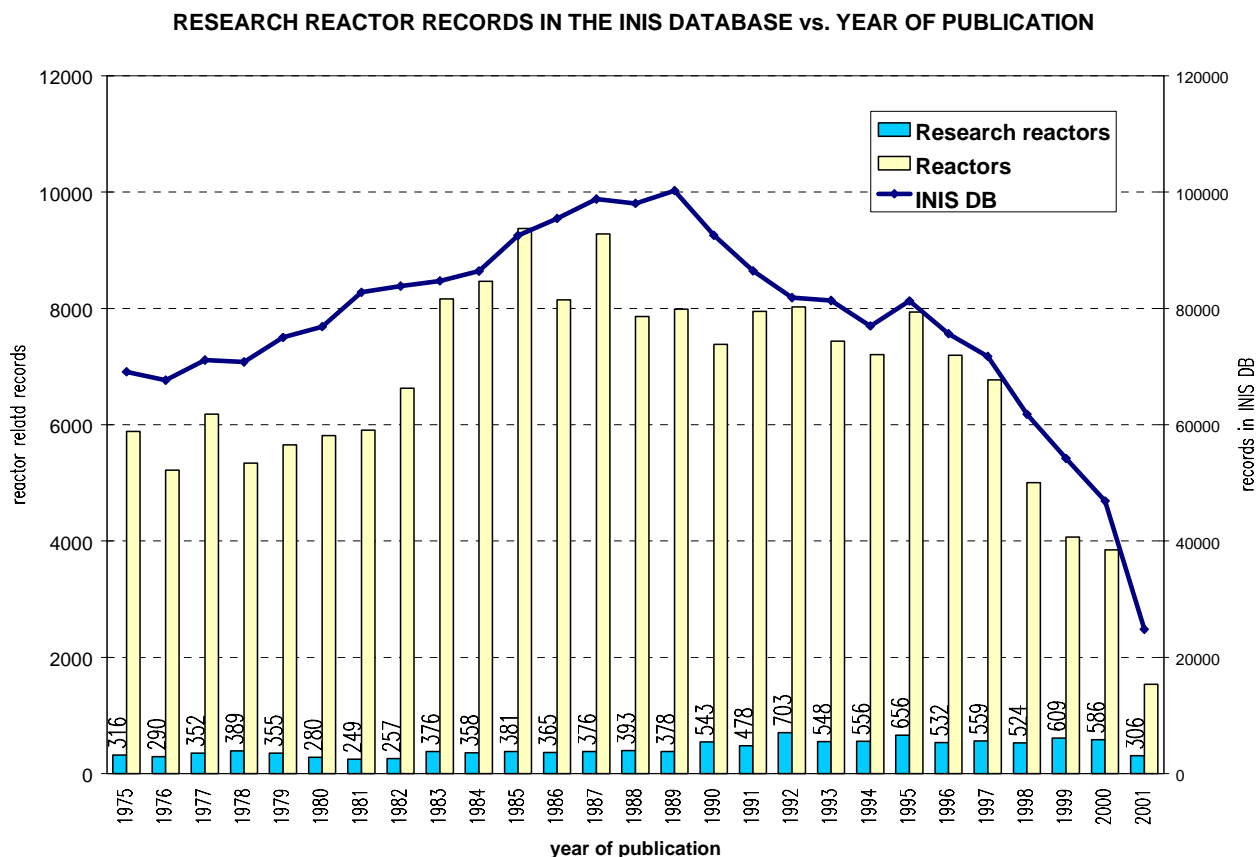
incomplete literature coverage. The following 25 years, from 1975-2001, were considered as relevant for this analysis. Records input in 2000 and 2001 must be considered as incomplete, due to the lead-in time for the database.

In December 2001, the total number of records in the INIS Database was 2,299,378 of which 195,422 records fall into fission reactor categories. The total number of records related to research reactors is 13,012. This means that about 8.5% of the records in INIS Database are in fission reactor categories. About 7% of records in fission reactor categories are related to research reactors.

Full text of 553,760 items present in the INIS Database are available from INIS (so called non-conventional literature, NCL) of which 62,020 most recently submitted ones are available from INIS in electronic form. Research reactors related articles available as full text from INIS amount to 6,457, of which 1,353 in electronic form.

The number of records related to research reactors versus year of publication is shown in Figure 1. These data are compared to the number of records in all the categories related to fission reactors and the total number of records in the INIS Database. The maximum number of records in research reactor category input in the INIS Database are related to items published in 1992. In the following few years this number was almost constant. This trend is similar to the total number of records in fission reactor categories.

Figure 1

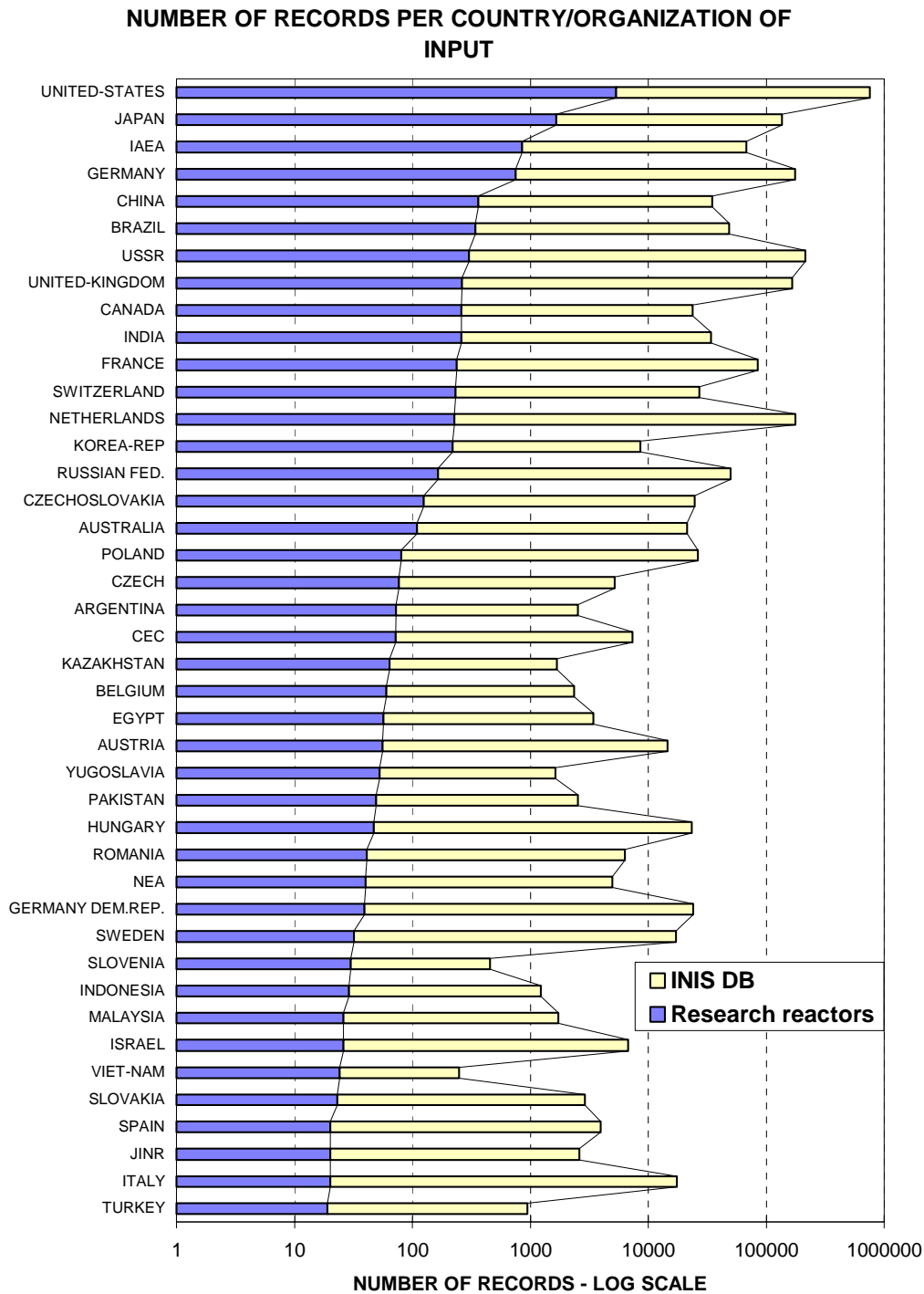


## Origin of input

During the period of 25 years, the records in the INIS database were sent by 119 Member countries or organisations, 87 countries/organisations have sent records assigned with primary fission reactor subject categories, and 77 countries/organisations contributed to the total of 13012 records classified as Research reactors.

Records in related to research reactors per INIS member state/organization of input are shown in Figure 2.

Figure 2



More detailed data are shown in Table 1. The highest contribution came from countries having the most developed nuclear programs which involve research and development in the field of fission reactor physics and technology. The comparison of records assigned research reactor primary category to total number of records in the INIS Database per country of input are shown as well.

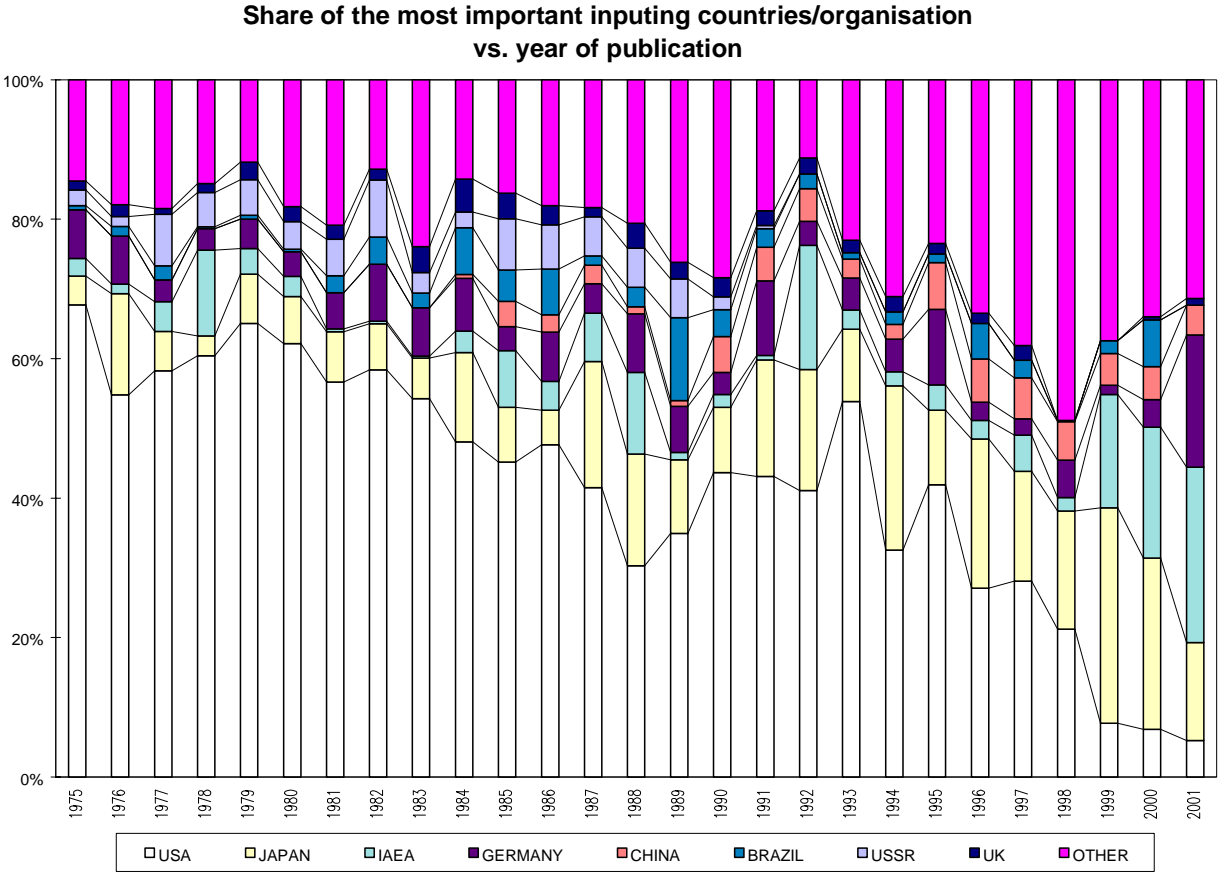
Table 1 Number of records related to Research reactors per INIS Member states/organizations

	COUNTRY/ORGANIZATION OF INPUT	No. of records		COUNTRY/ORGANIZATION OF INPUT	No. of records
1	UNITED-STATES	5327	40	SPAIN	20
2	JAPAN	1666	41	JINR	20
3	IAEA	856	42	TURKEY	19
4	GERMANY	750	43	CHILE	19
5	CHINA	361	44	SYRIAN ARAB REP.	17
6	BRAZIL	341	45	MEXICO	15
7	USSR	302	46	DENMARK	14
8	UNITED-KINGDOM	264	47	CUBA	14
9	CANADA	261	48	SOUTH AFRICA	13
10	INDIA	260	49	IRAQ	13
11	FRANCE	238	50	GREECE	13
12	SWITZERLAND	231	51	IRAN	12
13	NETHERLANDS	228	52	GHANA	11
14	KOREA-REP	220	53	UKRAINE	9
15	RUSSIAN FEDERATION	165	54	BULGARIA	8
16	CZECHOSLOVAKIA	124	55	FINLAND	8
17	AUSTRALIA	110	56	PHILIPPINES	8
18	POLAND	80	57	ICSTI	8
19	CZECH	77	58	PERU	6
20	ARGENTINA	73	59	VENEZUELA	6
21	CEC	72	60	COLOMBIA	5
22	KAZAKHSTAN	64	61	LIBYA	5
23	BELGIUM	60	62	NORWAY	4
24	EGYPT	57	63	BELARUS	3
25	AUSTRIA	56	64	PORTUGAL	3
26	YUGOSLAVIA	53	65	CMEA	2
27	PAKISTAN	49	66	CROATIA	2
28	HUNGARY	47	67	THAILAND	2
29	ROMANIA	41	68	ZAIRE	2
30	NEA	40	69	UZBEKISTAN	1
31	GERMANY DEM.REPUBLIC	39	70	UN	1
32	SWEDEN	32	71	LATVIA	1
33	SLOVENIA	30	72	NIGERIA	1
34	INDONESIA	29	73	MOROCCO	1
35	ISRAEL	26	74	BANGLADES	1
36	MALAYSIA	26	75	SAUDI ARABIA	1
37	VIET-NAM	24	76	DEMOCRATIC REP.KOREA	1
38	SLOVAKIA	23	77	AAEA	1
39	ITALY	20	TOTAL		13012

Eight countries/organisations have sent about 76% of all records related to research reactor technology. The biggest share of records related to research reactors was submitted by countries having a developed nuclear program, USA (40.9%), Japan (12.8%), Germany (5.8%). This indicates the interest in research reactors technology in the mentioned countries. The time dependence of number of records for the most important countries/organisations of input is shown in Figure 3.

The share of the IAEA (6.6%) is high due publishing of articles, reports, books, in the field of fission reactors resulting from the Agency’s task to promote nuclear technology and co-ordinate activities in development of related technology.

Figure 3



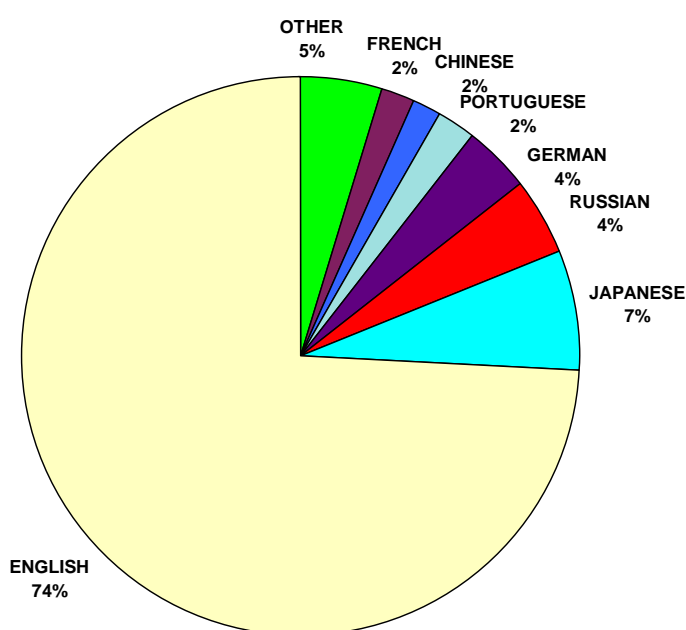
It is shown that the share of the USA is decreasing especially during the last few years. This is not the case of other important inputting countries/ organisations i.e. IAEA, Japan and Germany and China, but this is the case of United Kingdom.

## Languages

The majority of records related to research reactors refer to documents written in English (74%) which is somewhat higher than the use of English language in the total INIS Database (72%). One could conclude that the majority of authors from non-English speaking countries are submitting their publications in English, i.e. that the language of research and technology in the field of research reactors is English. The same conclusion is valid for the publications related to all other subjects in the scope of the INIS Database. Share of languages used in publications related to research reactors is shown in Figure 4.

Figure 4

**RESEARCH REACTOR RECORDS vs. LANGUAGE OF TEXT**



## Publication types

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

The share of publication types for items related to research reactors is shown Figure 5. Number of research reactor records compared to the total number of records in the INIS database per publication type is shown in Figure 6.

Figure 5

RESEARCH REACTOR ITEMS PER RECORD TYPE IN THE INIS DATABASE

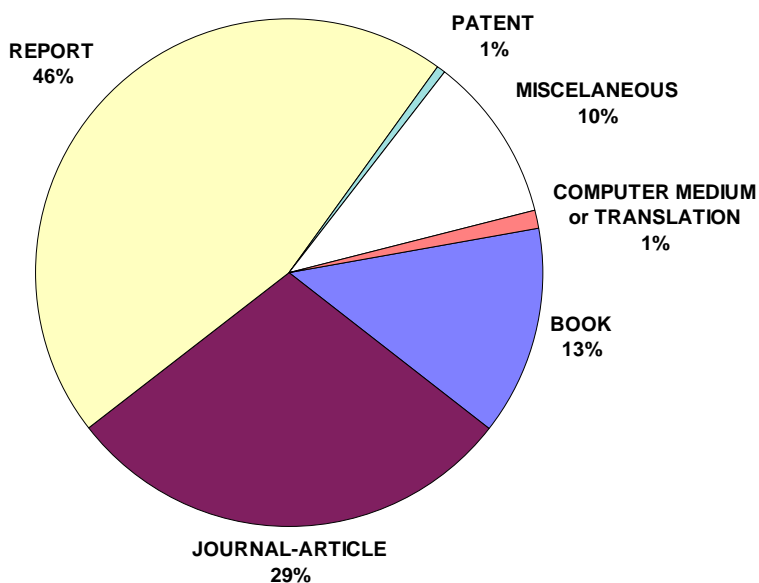
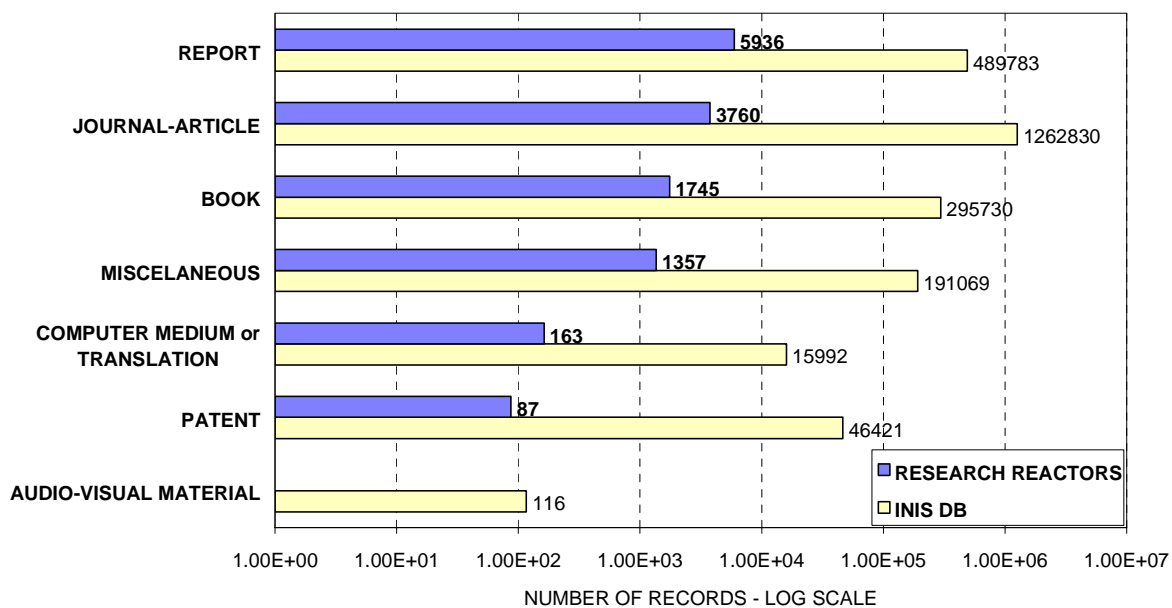


Figure 6

NUMBER OF RECORDS RELATED TO RESEARCH REACTORS vs. RECORD TYPE



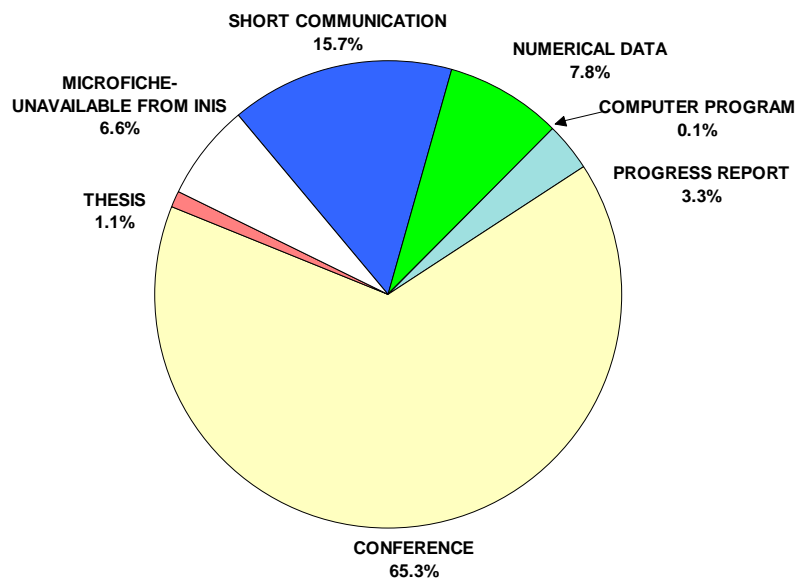
## Literary indicators

Besides record type, each item in the INIS Database is assigned a literary indicator. 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).

Share of literary types for research reactor records is shown in Figure 7.

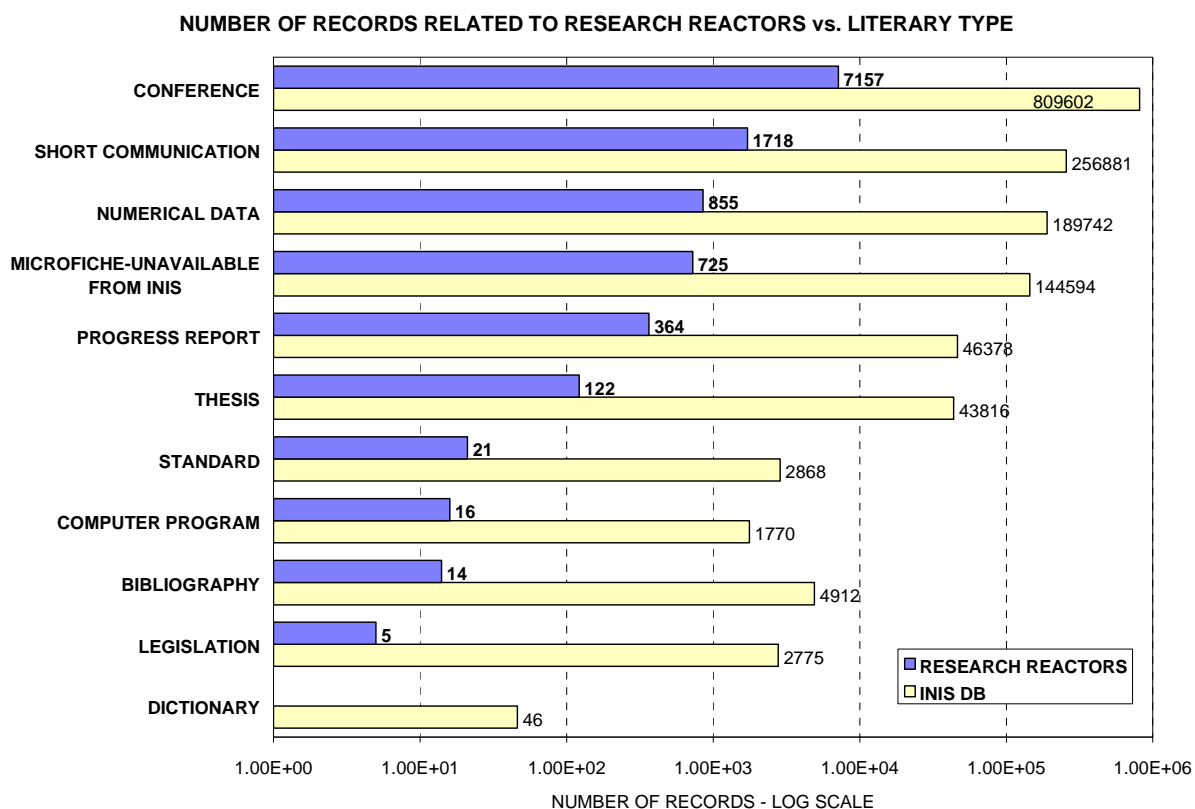
Figure 7

RESEARCH REACTOR ITEMS PER LITERARY TYPE IN INIS DATABASE



The number of records in the field of research reactors technology per literary type are shown in Figure 8 in comparison with the respective number of records per literary type in the INIS Database. The majority of records related to research reactors in the INIS Database are articles presented at conferences (65%), which is valid for the entire database as well. The share of literary indicators for research reactors related items is similar to the share for the database.

Figure 8



### Authors, Institutions and Countries

The INIS Database records names of authors, institutions and countries of origin. Names of authors are commonly specified for journal articles and books, but exist in many cases for other record types as well.

Country specific statistics referring to author's countries as well as to corporate entries are presented in Table 2. These data are independent of the country/organization of input, which are listed as well.

Figure 9 shows the distribution per country of records in the field of research reactors compared to the respective values in the entire INIS Database, using country information from the author field.

Corporate entries include corporate authors i.e. institutions responsible for the scientific content of publications and issuing organizations which are mentioned in the publication as editorially or organisationally responsible for the content of publication. Corporate author entries include academic institutions granting a degree, institutions organizing and/or sponsoring scientific meetings, as well as names of research institutes, laboratories, and names of conferences, symposia, meetings.

Table 2. Share of countries/organisations in the authors and corporate entry fields compared to share of records by country/organization of input for research reactors in the INIS Database

COUNTRY/ ORGANISATION	AUTHORS	SHARE (%)	CORPORATE ENTRY	SHARE (%)	COUNTRY OF INPUT	SHARE (%)
JAPAN	1481	11.4	1298	10.0	1666	12.8
UNITED-STATES	1000	7.7	1793	13.8	5327	40.9
GERMANY	567	4.4	698	5.4	789	6.1
CHINA	325	2.5	90	0.7	361	2.8
FRANCE	322	2.5	351	2.7	238	1.8
INDIA	298	2.3	254	2.0	260	2.0
RUSSIAN FED.	252	1.9	163	1.3	165	1.3
BRAZIL	247	1.9	268	2.1	341	2.6
CANADA	192	1.5	294	2.3	261	2.0
KOREA-REP	144	1.1	206	1.6	220	1.7
YUGOSLAVIA	117	0.9	43	0.3	53	0.4
NETHERLANDS	109	0.8	96	0.7	228	1.8
ITALY	94	0.7	82	0.6	20	0.2
CZECHOSLOVAKIA	86	0.7	49	0.4	124	1.0
UNITED-KINGDOM	83	0.6	32	0.2	264	2.0
ARGENTINA	81	0.6	90	0.7	73	0.6
EGYPT	78	0.6	59	0.5	57	0.4
BELGIUM	70	0.5	175	1.3	60	0.5
POLAND	69	0.5	67	0.3	80	1.8
SWITZERLAND	69	0.5	34	0.5	231	0.6
AUSTRIA	64	0.5	269	2.1	56	0.4
MEXICO	62	0.5	72	0.6	15	0.1
ROMANIA	56	0.4	40	0.3	41	0.3
CZECH	55	0.4	75	0.6	77	0.6
AUSTRALIA	54	0.4	66	0.5	110	0.8
HUNGARY	53	0.4	34	0.3	47	0.4
USSR	51	0.4	110	0.8	302	2.3
SLOVENIA	46	0.4	30	0.2	30	0.2
PAKISTAN	40	0.3	36	0.3	49	0.4
TURKEY	34	0.3	17	0.1	19	0.1
SWEDEN	33	0.3	37	0.3	32	0.2
ISRAEL	23	0.2	26	0.2	26	0.2
DENMARK	20	0.2	57	0.4	14	0.1
FINLAND	19	0.1	11	0.1	8	0.1
NORWAY	18	0.1	6	0.0	4	0.0
SPAIN	17	0.1	16	0.1	20	0.2
UKRAINE	14	0.1	10	0.1	9	0.1
OECD	13	0.1	2	0.0		0.0
BULGARIA	10	0.1	3	0.0	8	0.1
SLOVAKIA	2	0.0	18	0.1	23	0.2

Figure 9

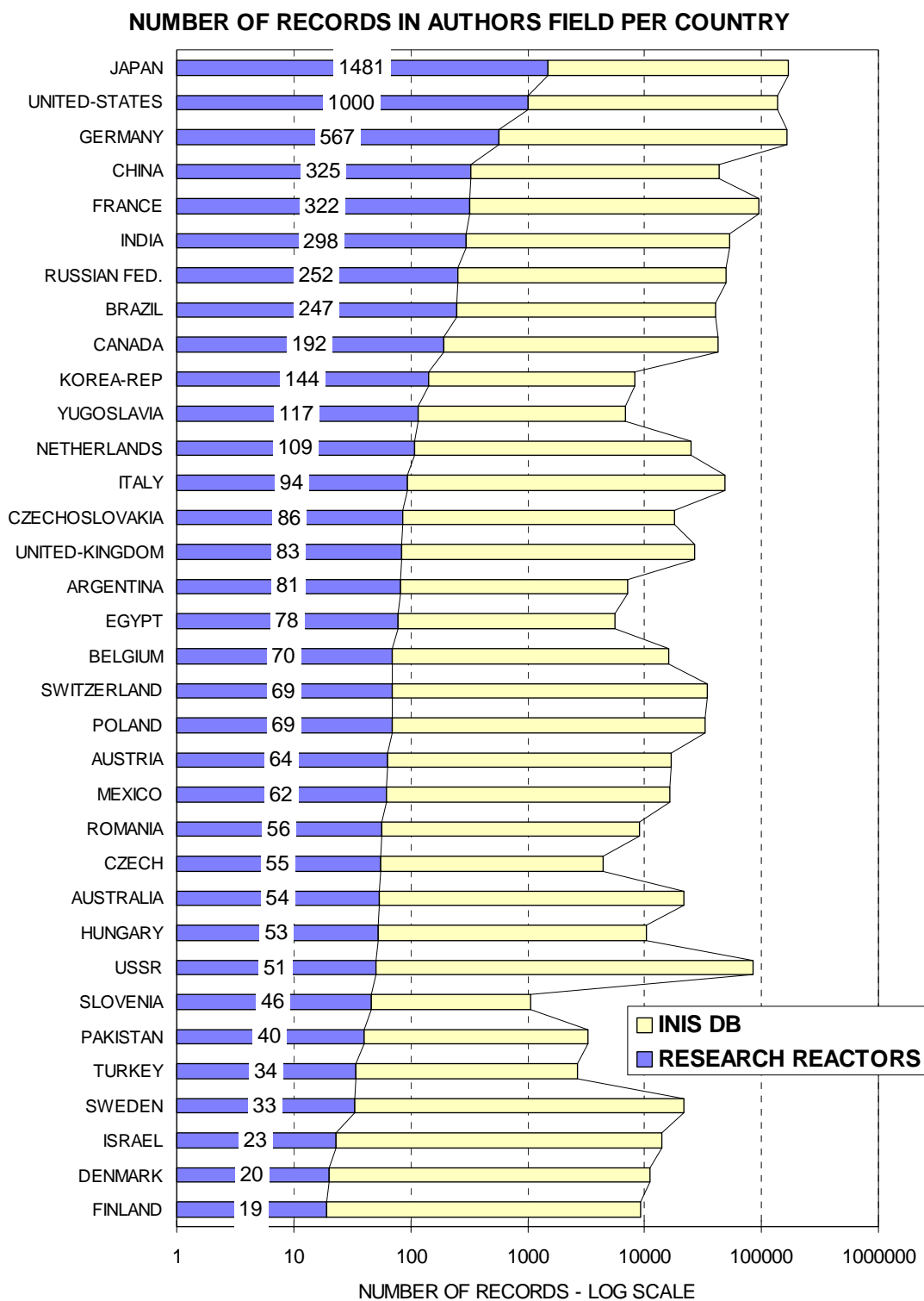
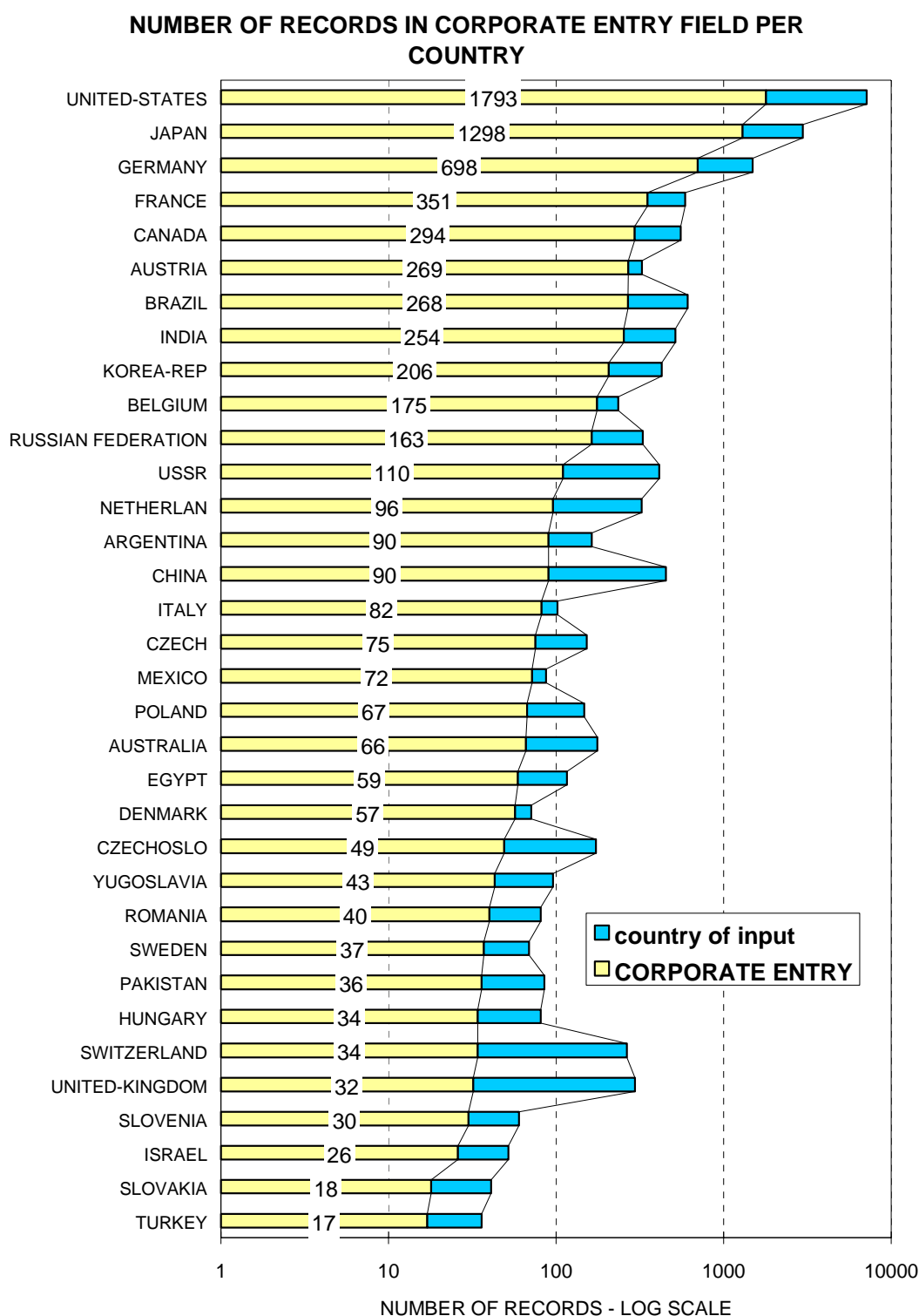


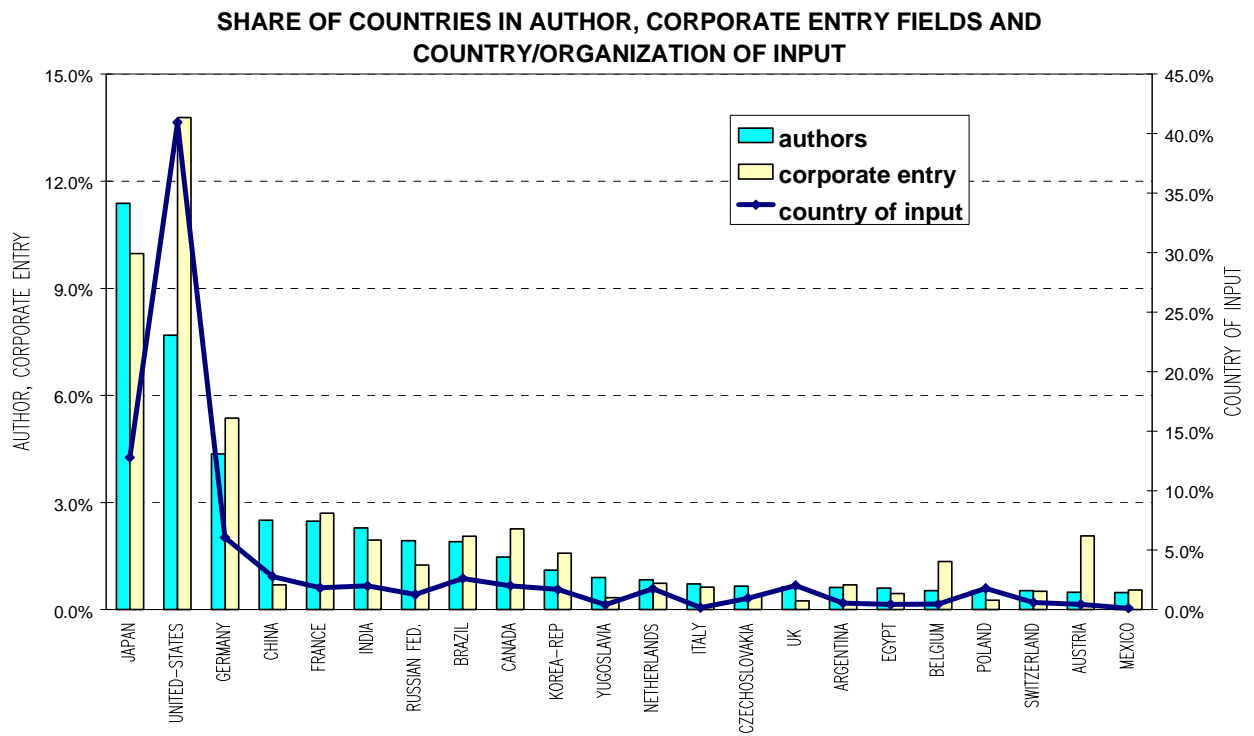
Figure 10 shows the country distribution of records in the research reactor category, using country information from the corporate entry and author field. These values are also independent of the country/organization of input.

Figure 10



The frequency of appearance of country names in the author field (Figure 9) was: Japan contributed 11.4%, USA 7.7%, Germany 4.4%, China 2.5%, France 2.5%, India 2.3%. The comparison of the ranking order of countries according to their appearance in author (Figure 9) and corporate entry (Figure 10) fields shows a difference. The ranking of country name in corporate entry field is different: USA is leading, contributing 13.8%, followed by Japan (10%), Germany (5.4%), France (2.7%), Canada (2.3%), etc. The share of records in research reactor category country in author and corporate entry fields is shown in Figure 11.

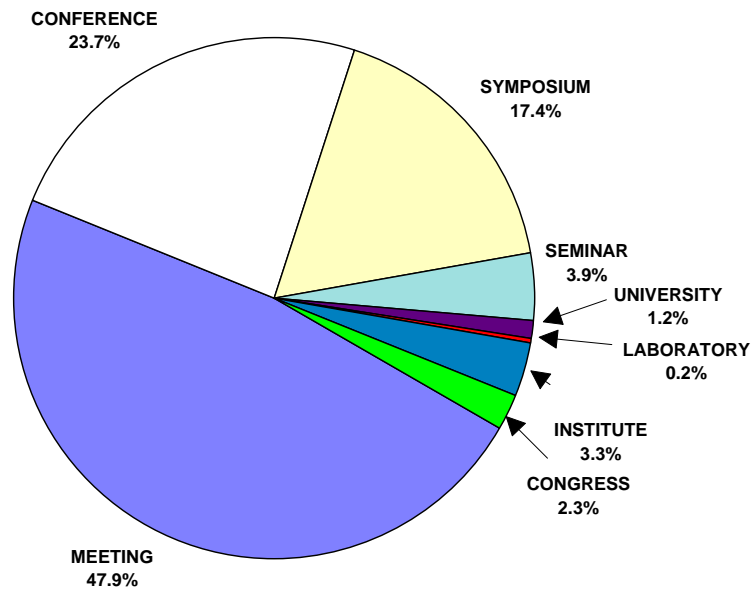
Figure 11



The share of some typical corporate entries in the field of research reactors is shown in Figure 12.

Figure 12

**SOME TYPICAL CORPORATE ENTRIES IN RESEARCH REACTOR CATEGORY**



## Concluding remarks

Quantitative data obtained in the present analysis show that 7% of records concerned with fission reactor related subject categories in the INIS Database are related to research reactors.

Number of countries/organizations that have contributed to the research reactor category was 77 out of 119 INIS Member States. Eight countries/organisations contributed about 76% of records falling into research reactor category: United States (41%), Japan (13%), IAEA (6.6%), Germany (6%), China (2.8%), Brazil (2.6%), USSR (2.3%), United Kingdom (2%). The share of records assigned with research reactor primary category per country of input indicate the interest in research reactor related research and technology in the mentioned countries. The case of the IAEA shows the interest of the international community in research and technology related to research reactors, since its task is to promote and co-ordinate activities in development of nuclear science and technology.

The majority of records in the research reactor category refer to pieces of literature written in English (74%). One could conclude that the majority of authors from non-English speaking countries are submitting their publications in English, i.e. that the language of research and technology in research reactors is English, which is valid for the publications related to fission reactors and all the subjects in the scope of the INIS Database (72%).

The distribution of the number of research reactor records by record type shows that 46% are reports, almost one third (29%) are journal-articles, and 13% are books. Analysis of the number of records by literary type shows that the majority of records (65%) in research reactor category were published as conference publications.

The appearance of country names in the author field was: Japan 11.4%, USA (7.7%), Germany 4.4%, China 2.5%, France 2.5%, India 2.3%, Russian Federation 1.9%, Brazil 1.9%, Canada 1.9%, etc. The appearance of country name in the corporate entry field is different: USA is leading contributing 13.8%, followed by Japan (10%), Germany (5.4%), France (2.7%), Canada (2.3%), Brazil (2.1%), etc.

## 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