

A SCIENTOMETRIC ANALYSIS OF NUCLEAR POWER GENERATION RESEARCH: A STUDY

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ABSTRACT

This paper attempts to analyze quantitatively the growth and development of nuclear power generation in global terms of publication output as reflected in Web of Science (WOS) database during 1980 to 2013. A total of 2016 papers were published by the researchers in various domains; in the Research areas Nuclear Science Technology topped with 836 documents (41%) were published, most of them are Journal article as document type with 1851(92%) and the most preferred journals were Nuclear Engineering Design with 117(6%). Among 417 contributed institutions from 34 various countries, Korea Atom Energy Research Institute ranked first with 31(2%) papers. The Country based analysis USA ranked 1st with 512 records (25%) publications followed by Germany 11% and India ranked 12th with 51(3%) records. Among the total 628 authors, Lior N topped with 10 articles and the Year wise analysis showed that Nuclear Power Generation papers gradually increased with an average of 134 records per year, from the starting year 1999 with 61(3%), and 2012 topped with 242(12%) and slashed with 2013 with 214(11%).

Keywords: Scientometrics, Nuclear Power Generation (NPG), Authorship pattern, Subject wise distribution, Geographical distribution.

1. INTRODUCTION

Scientometrics is the quantitative study of the disciplines of science based on published literature and communication. This could include identifying the emerging areas of scientific research, examining the development of research over time, or geographic and organizational distributions of research. In this study, we did the Scientometrics analysis of Nuclear Power Generation Research, a significantly growing area in the knowledge driven world.

2. REVIEW OF LITERATURE

Peter Vinkler (2008) in his book, illustrated various facets of scientometric indicators like practical and realistic quantitative methods for evaluating scientific publication activities of individuals, teams, countries and journals, standardized descriptions and classification of the main categories of evaluative Scientometrics.

Thanuskodi, S. and Umamaheswari, P. (2013) has analyzed Electronic Journal of Knowledge Management from 2007 to 2011 with 197 articles; a variety of data analysis methods are

employed during Bibliometric analysis, including: co-authorship analysis, co-citation analysis.

Dutt, Garg and Bali (2003) analyzed 1317 papers published in the first fifty volumes of the International journal of Scientometrics during 1978 to 2001. They found that the share of papers by USA is constantly declining while that of the Netherlands, India, France and Japan is on the rise. The research output is highly scattered as indicated by the average number of papers per institution.

3. SCOPE AND METHODOLOGY

The present study attempts to find out the publication pattern of global researchers in the field of Nuclear Power Generation (NPG). The study is based on the references and aims to analyze quantitatively the growth and development of NPG research in world terms of publication output as reflected in *Web of Science (WOS)* database during years, 1980 to 2013.

4. OBJECTIVES OF THE STUDY

The main objective of the study is to present the growth of literature and make the quantitative assessment of status of Nuclear Power Generation (NPG) research by analyzing the various features.

The specific objectives are:

- To measure the Year wise growth of Publications
- To measure the Document wise publications
- To measure the Country wise distribution
- To measure the Institution wise distribution
- To measure the Source wise publications
- To measure the Language wise distributions
- To measure the Research area/Subject wise publications

5. RESULTS AND DISCUSSIONS

5.1. Year-wise distribution of Publications

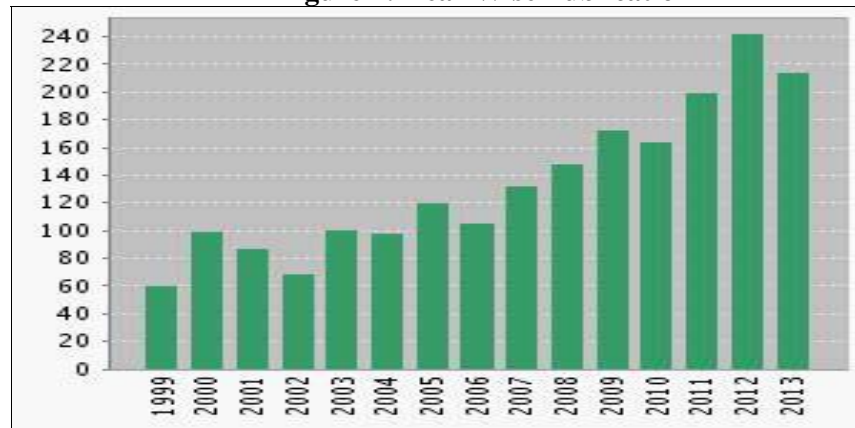
During the study period 1980 to 2013, the Year wise analysis reflected with average 288 papers per year. In 2008 topped with 745 publications slashed with 2009 with 549 and the lowest were in year 1999 with 129 publications. The trend shows that Nuclear Power Generation (NPG) publications have gradually increased. (Table 1 and Figure 1 show 15 years contributions).

Table 1: Year wise distribution of publications

S. No.	Year	Records	2016%	Cumulative	Cumulative %
1	1999	61	3.026	61	3.025793651
2	2000	69	3.423	130	6.448412698
3	2001	87	4.315	217	10.76388889
4	2002	98	4.861	315	15.625
5	2003	99	4.911	414	20.53571429
6	2004	101	5.01	515	25.54563492

7	2005	106	5.258	621	30.80357143
8	2006	120	5.952	741	36.75595238
9	2007	133	6.597	874	43.3531746
10	2008	149	7.391	1023	50.74404762
11	2009	164	8.135	1187	58.87896825
12	2010	173	8.581	1360	67.46031746
13	2011	200	9.921	1560	77.38095238
14	2012	242	12.004	1802	89.38492063
15	2013	214	10.615	2016	100
Total		2016	100		

Figure 1: Year Wise Publication



5.2. Author wise contributions

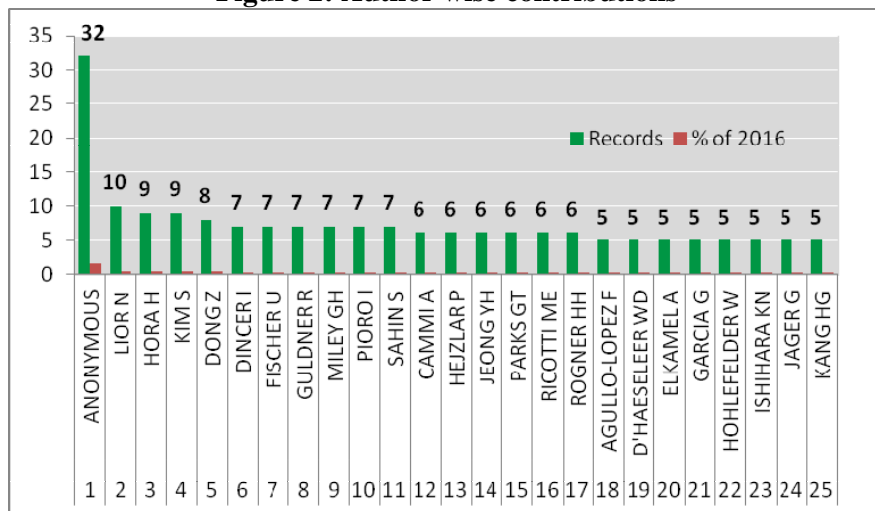
Author wise contributions shows, the total 628 authors published their contributions in the field of Nuclear Power Generation (NPG). The Total 32 records published without the author name mentioned with Anonymous. Lior N ranked first and published 10 articles, Hora H with 9 and Kim S with 9. (Table 2 and Figure 2 show top 25 authors contributions).

Table 2: Author wise contributions

S. No.	Authors	Records	% of 2016
1	ANONYMOUS (no author name available)	32	1.587
2	LIOR N	10	0.496
3	HORA H	9	0.446
4	KIM S	9	0.446
5	DONG Z	8	0.397
6	DINCER I	7	0.347
7	FISCHER U	7	0.347
8	GULDNER R	7	0.347
9	MILEY GH	7	0.347
10	PIORO I	7	0.347
11	SAHIN S	7	0.347
12	CAMMI A	6	0.298

13	HEJZLAR P	6	0.298
14	JEONG YH	6	0.298
15	PARKS GT	6	0.298
16	RICOTTI ME	6	0.298
17	ROGNER HH	6	0.298
18	AGULLO-LOPEZ F	5	0.248
19	D'HAESELEER WD	5	0.248
20	ELKAMEL A	5	0.248
21	GARCIA G	5	0.248
22	HOHLEFELDER W	5	0.248
23	ISHIHARA KN	5	0.248
24	JAGER G	5	0.248
25	KANG HG	5	0.248

Figure 2: Author wise contributions



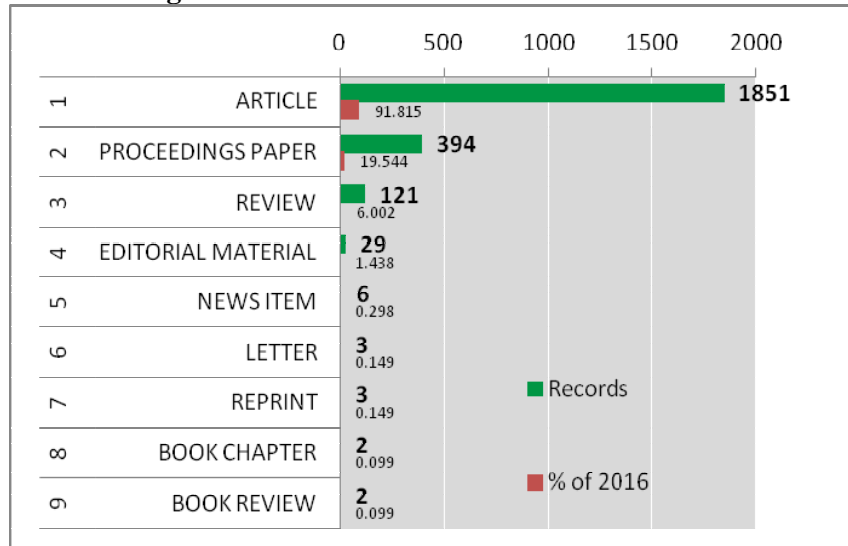
5.3. Document Wise Distribution

The total of 2016 publications in the global parameters, the highest number of publications were 1851 (92%) Journal articles, Proceedings Paper 394 (20%), Review 121 (6%), and so on. (Table 3 and Figure 3 show the document wise contributions clearly).

Table 3: Document Wise Publication

S. No.	Document Types	Records	% of 2016
1	ARTICLE	1851	91.815
2	PROCEEDINGS PAPER	394	19.544
3	REVIEW	121	6.002
4	EDITORIAL MATERIAL	29	1.438
5	NEWS ITEM	6	0.298
6	LETTER	3	0.149
7	REPRINT	3	0.149
8	BOOK CHAPTER	2	0.099
9	BOOK REVIEW	2	0.099

Figure 5: Document Wise Publication



5.4. Research Area/Subject wise contribution

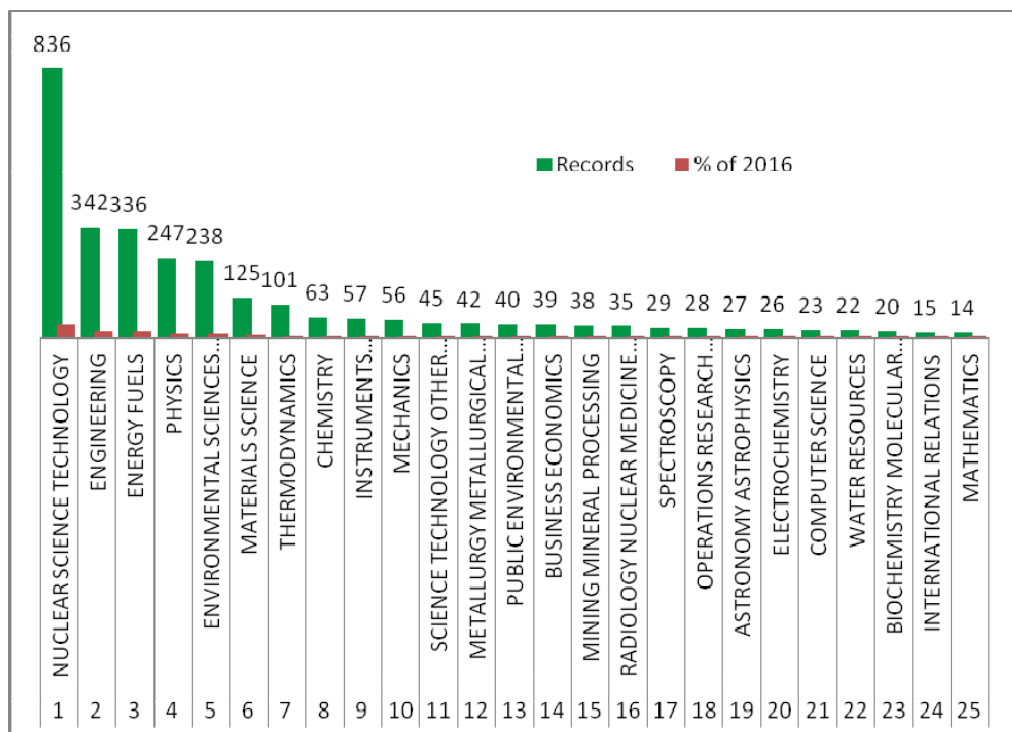
The global Nuclear Power Generation (NPG) has produced 43 research areas in the WOS Nuclear Science Technology 836 (41.4%), Engineering 342 (16.9%), Energy fuels 336 (16.6%) Physics 247 (12%) and so on. (Table 4 and Figure 4 clearly show the top 25 research areas contributions).

Table 4: Research Area/ Subject wise contribution

S. No.	Research Areas	Records	% of 2016
1	NUCLEAR SCIENCE TECHNOLOGY	836	41.468
2	ENGINEERING	342	16.964
3	ENERGY FUELS	336	16.667
4	PHYSICS	247	12.252
5	ENVIRONMENTAL SCIENCES ECOLOGY	238	11.806
6	MATERIALS SCIENCE	125	6.2
7	THERMODYNAMICS	101	5.01
8	CHEMISTRY	63	3.125
9	INSTRUMENTS INSTRUMENTATION	57	2.827
10	MECHANICS	56	2.778
11	SCIENCE TECHNOLOGY OTHER TOPICS	45	2.232
12	METALLURGY METALLURGICAL	42	2.083
13	PUBLIC ENVIRONMENTAL OCCUPATIONAL	40	1.984
14	BUSINESS ECONOMICS	39	1.935
15	MINING MINERAL PROCESSING	38	1.885
16	RADIOLOGY NUCLEAR MEDICINE MEDICAL IMAGING	35	1.736
17	SPECTROSCOPY	29	1.438
18	OPERATIONS RESEARCH MANAGEMENT SCIENCE	28	1.389
19	ASTRONOMY ASTROPHYSICS	27	1.339

20	ELECTROCHEMISTRY	26	1.29
21	COMPUTER SCIENCE	23	1.141
22	WATER RESOURCES	22	1.091
23	BIOCHEMISTRY MOLECULAR BIOLOGY	20	0.992
24	INTERNATIONAL RELATIONS	15	0.744
25	MATHEMATICS	14	0.694

Figure 4: Research Area/ Subject wise contribution



5.5. Country wise Distribution

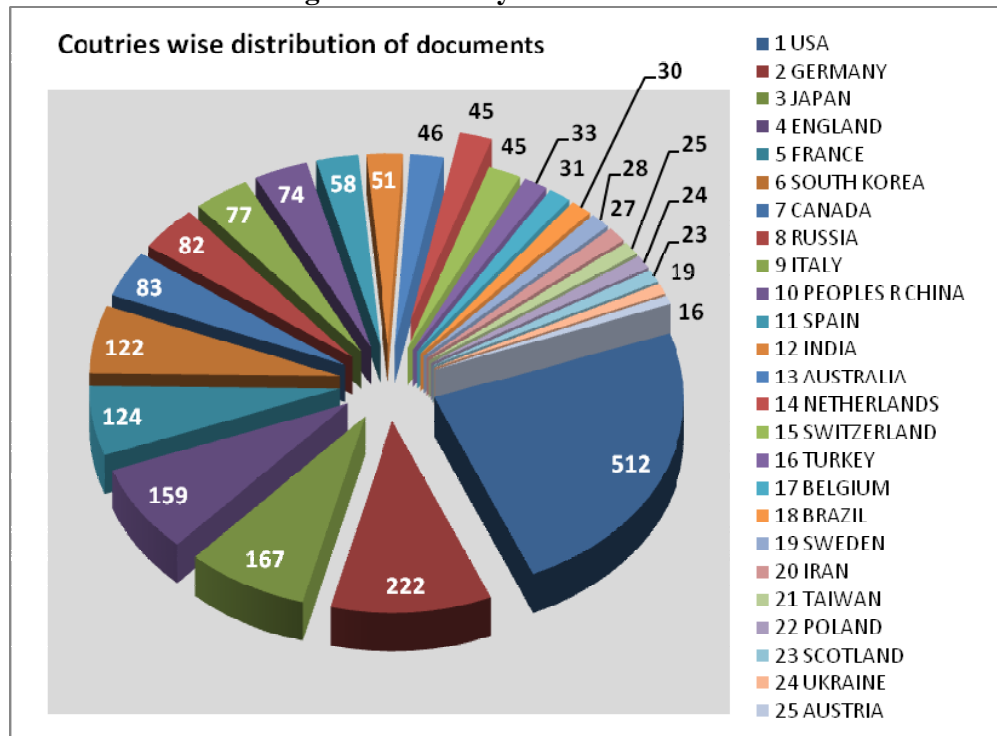
The country wise distribution said that 34 different countries with 2016 documents in the field of Nuclear Power Generation (NPG). The USA ranked topped with 512 (25%) publications, Germany 222 (11%), Japan 167 (8%), UK 159 (8%), France 124 (6.1%), South Korea 122 (6%) and Canada 83 (4%). India published 51 (2.5%) publications with 12th position. The following Table 5 and Figure 5 show the top 25 countries contributions in this field.

Table 5: Country wise Distribution

S. No.	Countries/Territories	Records	% of 2016
1	USA	512	25.397
2	GERMANY	222	11.012
3	JAPAN	167	8.284
4	ENGLAND	159	7.887
5	FRANCE	124	6.151
6	SOUTH KOREA	122	6.052
7	CANADA	83	4.117

8	RUSSIA	82	4.067
9	ITALY	77	3.819
10	PEOPLES R CHINA	74	3.671
11	SPAIN	58	2.877
12	INDIA	51	2.53
13	AUSTRALIA	46	2.282
14	NETHERLANDS	45	2.232
15	SWITZERLAND	45	2.232
16	TURKEY	33	1.637
17	BELGIUM	31	1.538
18	BRAZIL	30	1.488
19	SWEDEN	28	1.389
20	IRAN	27	1.339
21	TAIWAN	25	1.24
22	POLAND	24	1.19
23	SCOTLAND	23	1.141
24	UKRAINE	19	0.942
25	AUSTRIA	16	0.794

Figure 5: Country wise Distribution



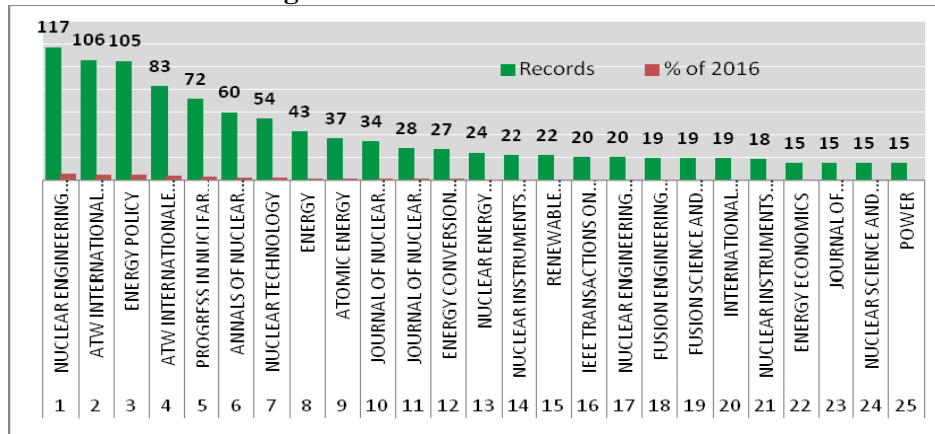
5.6. Source wise Distribution

Source wise analysis shows that, Nuclear Power Generation (NPG) publications published in 174 Source titles. The highest numbers of publications were in Nuclear Engineering and Design 117 (5.8%) followed by ATW International Journal for Nuclear Power 106 (5.2%), Energy Policy 105 (5.2%) and so on. The following Table 6 and Figure 6 show the top 25 ranking Source Titles during the 15 year period study period.

Table 6: Source wise Distribution

S. No.	Source Titles	Records	% of 2016
1	NUCLEAR ENGINEERING AND DESIGN	117	5.804
2	ATW INTERNATIONAL JOURNAL FOR NUCLEAR POWER	106	5.258
3	ENERGY POLICY	105	5.208
4	ATW INTERNATIONALE ZEITSCHRIFT FUR ENERGIE	83	4.117
5	PROGRESS IN NUCLEAR ENERGY	72	3.571
6	ANNALS OF NUCLEAR ENERGY	60	2.976
7	NUCLEAR TECHNOLOGY	54	2.679
8	ENERGY	43	2.133
9	ATOMIC ENERGY	37	1.835
10	JOURNAL OF NUCLEAR SCIENCE AND TECHNOLOGY	34	1.687
11	JOURNAL OF NUCLEAR MATERIALS	28	1.389
12	ENERGY CONVERSION AND MANAGEMENT	27	1.339
13	NUCLEAR ENERGY JOURNAL OF THE BRITISH NUCLEAR ENERGY SOCIETY	24	1.19
14	NUCLEAR INSTRUMENTS METHODS IN PHYSICS RESEARCH SECTION B BEAM	22	1.091
15	RENEWABLE SUSTAINABLE ENERGY REVIEWS	22	1.091
16	IEEE TRANSACTIONS ON NUCLEAR SCIENCE	20	0.992
17	NUCLEAR ENGINEERING AND TECHNOLOGY	20	0.992
18	FUSION ENGINEERING AND DESIGN	19	0.942
19	FUSION SCIENCE AND TECHNOLOGY	19	0.942
20	INTERNATIONAL JOURNAL OF HYDROGEN ENERGY	19	0.942
21	NUCLEAR INSTRUMENTS METHODS IN PHYSICS RESEARCH SECTION A	18	0.893
22	ENERGY ECONOMICS	15	0.744
23	JOURNAL OF ENGINEERING FOR GAS TURBINES AND POWER TRANSACTIONS OF THE ASME	15	0.744
24	NUCLEAR SCIENCE AND ENGINEERING	15	0.744
25	POWER	15	0.744

Figure 6: Source wise Distribution



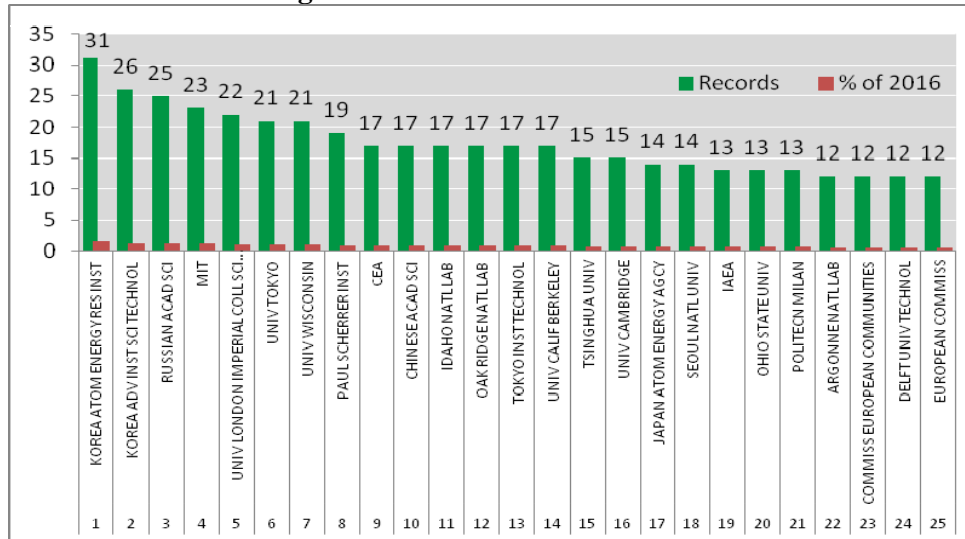
5.7. Organizations wise Distribution

Although 417 organisations/Institutions have published the articles in Nuclear Power Generation (NPG), The Korea Atomic Energy research Institute 31 (1.5%), followed by Korea Advanced Institute of Science Technology 26 (1.29), Russian Academy of Sciences 25 (1.24%) and so on. The following Table 7 and Figure 7 show that top 25 most productive institutions in NPG field.

Table 7: Source wise Distribution

S. No.	Organizations	Records	% of 2016
1	KOREA ATOMIC ENERGY RESEARCH	31	1.538
2	KOREA ADVANCED INSTITUTE OF SCIENCE	26	1.29
3	RUSSIAN ACADEMY OF SCIENCES	25	1.24
4	MIT	23	1.141
5	UNIVERSITY OF LONDON IMPERIAL COLL	22	1.091
6	UNIVESITY OF TOKYO	21	1.042
7	UNIVERSITY OF WISCONSIN	21	1.042
8	PAUL SCHERRER INSTITUTE	19	0.942
9	CEA	17	0.843
10	CHINESE ACADEMIC OF SCIENCES	17	0.843
11	IDAHO NATIONAL LABORATERIES	17	0.843
12	OAK RIDGE NATIONAL LABBORATERIES	17	0.843
13	TOKYO INSTITUTE OF TECHNOLOGY	17	0.843
14	UNIVESITY OF CALIF BERKELEY	17	0.843
15	TSINGHUA UNIVERSITY	15	0.744
16	UNIVERSITY OF CAMBRIDGE	15	0.744
17	JAPAN ATOMIC ENERGY AGENCY	14	0.694
18	SEOUL NATIONAL UNIVERSITY	14	0.694
19	IAEA	13	0.645
20	OHIO STATE UNIVERSITY	13	0.645
21	POLITECHNIC UNIVERSITY OF MILAN	13	0.645
22	ARGONNE NATIONAL LABORATERIES	12	0.595
23	COMMISS EUROPEAN COMMUNITIES	12	0.595
24	DELFT UNIVERSITY OF TECHNOLOGY	12	0.595
25	EUROPEAN COMMISSION	12	0.595

Figure 7: Source wise Distribution

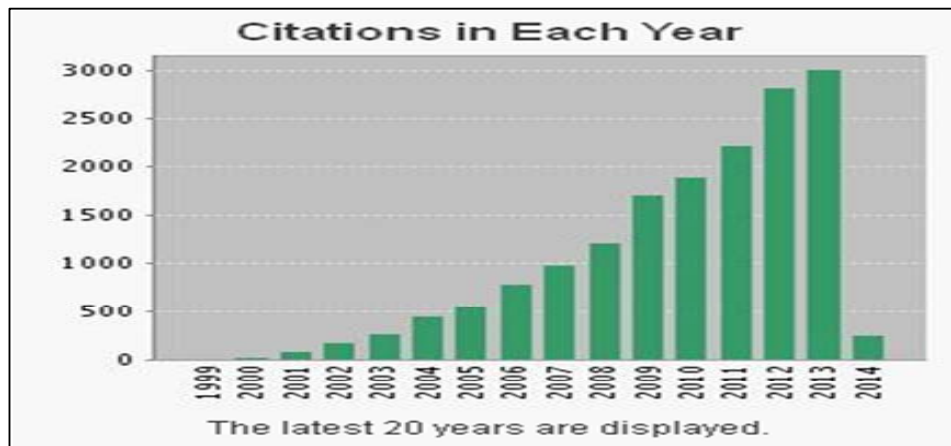


5.8. Citations in each year

The citation wise from the study period, the highest citations received from the year 2013. Sum of total times cited articles are 16463 and its average citation per item is 8.17. The publication h-index value is 55.

- Sum of Times Cited without self-citations: 15799
- Citing Articles: 14663
- Citing Articles without self-citations: 14343

Figure 8: Citations in each year



6. CONCLUSION

This paper has highlighted quantitatively the contributions made by the Nuclear Power Generation (NPG), as reflected in Web of Science (WOS) database. During 15 years period the USA is lead in nuclear research publications and USA ranked 1st with 25% publications followed by Germany 11% and India ranked 12th with 3%. In the Year wise analysis showed

that Nuclear Power Generation papers gradually increased with an average of 134 records per year, from the starting year 1999 with 61(3%), and 2012 topped with 242(12%) and slashed with 2013 with 214(11%). Generally, results of this study revealed that the contribution of Nuclear Power Generation (NPG) research literature is on gradual rise.

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