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Improvements to SFCOMPO – a Database on Isotopic Composition of Spent Nuclear Fuel

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Isotopic composition is one of the most relevant data to be used in the calculation of burnup of irradiated nuclear fuel. Since autumn 2002, the Organisation for Economic Co-operation and Development/Nuclear Energy Agency (OECD/NEA) has operated a database of isotopic composition – SFCOMPO, initially developed in Japan Atomic Energy research Institute. This paper describes the latest version of SFCOMPO and the future development plan in OECD/NEA.

KEYWORDS: SFCOMPO, JAERI, NEA, Post Irradiation Examination, Isotopic Composition, Database

1. Introduction

Isotopic composition of spent nuclear fuel (SNF), obtained in post irradiation experiments (PIE) is one of the important components required in the validation of burnup credit methodologies. This led the Japan Atomic Energy Research Institute (JAERI) in 1993 to start developing, SFCOMPO, a database for isotopic composition of SNF.[1,2] Data were collected from the open literature and at first compiled on a database management system on a personal computer.

In the mid-1990's, the World Wide Web started to be widely used by the scientific community and interfaces between Web-based services and relational databases became available. SFCOMPO was then upgraded to use this new technology for the collection and display of data, using the freely available relational database system PostgreSQL.[3,4]

In order to provide an international framework for the collection, dissemination and further development of the database, SFCOMPO was migrated from JAERI to the NEA Web server in autumn 2002.

In this paper, the outline of the SFCOMPO database as operated on the web site of the Organisation for Economic Co-operation and Development/Nuclear Energy Agency (OECD/NEA), will be presented and the plans for its future development will be discussed.

2. Current Status of SFCOMPO

2.1 Operation of SFCOMPO in NEA

The Expert Group on Burnup Credit Criticality Safety (EGBUC) is a technical group of the Working Party on Nuclear Criticality Safety (WPNCS) under Nuclear Science Committee of OECD/NEA. The EGBUC treats issues related to burnup credit. From the beginning of development of SFCOMPO in JAERI, there was a general consensus in EGBUC to support SFCOMPO project.

Considering the requirement to gather new PIE data from many countries and input them into the database, it seems natural to operate SFCOMPO in an international organization such as the NEA.

Based on this idea, the transfer was done in the first half of 2001. The transfer of the database from JAERI to NEA was straightforward, as SFCOMPO had been developed using common software. Since autumn 2002, SFCOMPO is being operated on the NEA web site, and the database can be freely accessed at the URL: http://www.nea.fr/html/science/wpncs/sfcompo/.

2.2 Status of SFCOMPO

2.2.1 Outline

Table 1[5] summarizes the current status of the database. It contains measured isotopic composition data from 14 reactors (7 PWRs and 7 BWRs) in 4 countries. Data from 246 samples are available, including 30 samples from fuels using burnable absorbers (UO_2-Gd_2O_3). The database provides the composition for U, Pu, Am, Cm and several fission products (Nd, Cs, Sr). Since not only measured data but also ratios of the measured data are included, more than 10,000 data points are registered.

2.2.2 General Description of PIE data

The latest version of SFCOMPO provides general information on all PIE data in HTML format.[4] The position of the sample in fuel assemblies and within the fuel rods are also given as clickable maps whenever this data are available.[4] Some PIE data contain the history of fuel assembly shuffling and reactor operation.

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These data are important both for understanding and for conducting the analysis of PIE.

Table 1 List of data in current SFCOMPO[5)]

Reactor	Country	Type	Fuel Type	NB[1]
Obrigheim	Germany	P[3]	14×14	23
Gundre-mmingen	Germany	B[4]	6×6	12
Trino Vercellese	Italy	P	15×15	39
JPDR	Japan	B	6×6	30
Tsuruga-1	Japan	B	7×7	10
Fukushima-Daiichi-3	Japan	B	8×8	36 (10)[2]
Fukushima-Daini-2	Japan	B	8×8	18 (10)
Mihama-3	Japan	P	15×15	9
Genkai-1	Japan	P	14×14	2
Takahama-3	Japan	P	17×17	16(5)
Cooper	USA	B	7×7	6
Monticello	USA	B	8×8	30(5)
Calvert Cliffs-1	USA	P	14×14	9
H.B. Robinson-2	USA	P	15×15	6

1- Total Number of Sample, 2 - Numbers in ( ) are number of UO_2-Gd_2O_3 fuel sample, 3 - PWR, 4 - BWR

2.3 New Function of SFCOMPO

At the occasion of transferring SFCOMPO, we added several functions for further utilization of data.

2.3.1 Preparation of figures

One of the useful functions of SFCOMPO is to generate viewgraph displaying the variation of selected composition data against measured burn-up. In the current version, the format of the figures was changed from GIF to PNG, since we found that some versions of the plotting tool, used in SFCOMPO, cannot produce GIF formatted files because of copyright problems. Besides, SFCOMPO can also produce PostScript formatted files, providing a higher quality than PNG files, and thus more suitable for inclusion in a document. Figure 1 is an example.

2.3.2 Numerical data in text file

Numerical data used for generating the viewgraphs can be obtained in text format. SFCOMPO also makes tables of numerical data in HTML formatted files. However, this format is not suitable for further data treatment and it is therefore recommended to use the simple text formatted files for further treatment of the numerical data.

2.3.3 Expansion of data table

In previous versions of SFCOMPO, the cooling time was fixed for each PIE data set. However, for some PIE samples, each isotope has a different cooling time. This is because it was not possible to perform isotope dependent decay corrections. To reflect this situation, the database table was extended to input the cooling time for each measured data point. The cooling time is shown in the table of retrieved data and in the viewgraph in Figure 1.

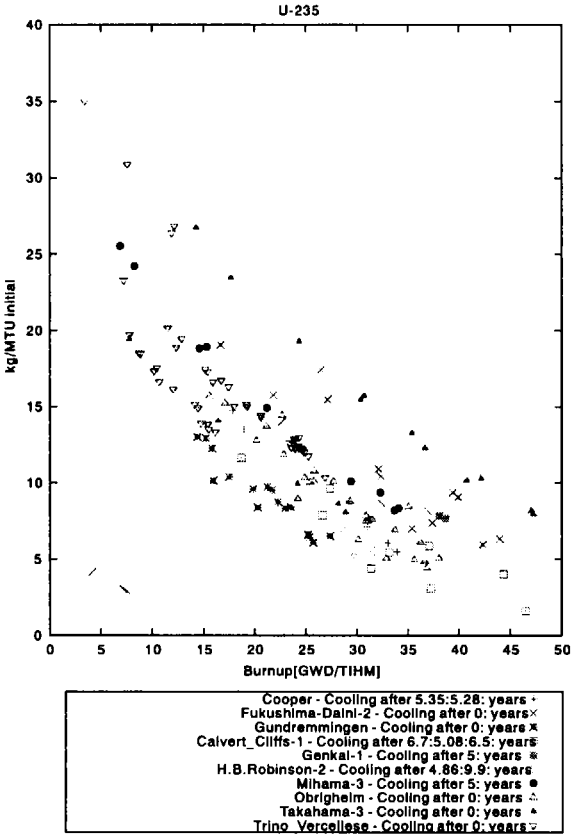

Fig.1 An example of viewgraph generated by SFCOMPO – ^{235}U weight (kg/initial heavy metal)

3. Further development

Recent technical development has made it possible to provide direct access to the SFCOMPO database through the Internet.

To further develop the usefulness of SFCOMPO, it is required to add new data into the database. As initially intended, it is hoped that, using the framework of OECD/NEA, would facilitate the collection of new data from international community, even though several PIE data are commercially restricted.

If other, already published, PIE data are found in the open literature, they should also be included. For example, PIE data measured in JAERI had not been included in the SFCOMPO since the name of reactor had not been revealed in the report. [6)] It is thus necessary to receive information and feedback from users in international community to point out if there are open PIE data, which are not included in SFCOMPO.

In addition, there are more resources needed to

compile data from opened reports regarding the description of PIE and possibly regarding the evaluation of PIE data.

In order to improve and facilitate the management of the SFCOMPO database, the NEA will develop a tool to edit the data through web browser.

4. Conclusion

The SFCOMPO database is successfully operating on the NEA web server. This is the only freely accessible database on PIE data. Input of new data will be performed under the international framework of OECD/NEA.

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