Data Article

Data from calorimetric decay heat measurements of five used PWR 17x17 nuclear fuel assemblies

Peter Jansson a, *, Martin Bengtsson b, Ulrika Bäckström b, Kjell Svensson b, Mattias Lycksell b, Anders Sjöland b

a Uppsala University, Sweden
b Swedish Nuclear Fuel and Waste Management Company, Sweden

A R T I C L E   I N F O

Article history:
Received 25 October 2019
Received in revised form 22 November 2019
Accepted 25 November 2019
Available online 2 December 2019

Keywords:
Spent nuclear fuel
Decay heat
Calorimetry
Calorimetric measurement

A B S T R A C T

Raw data from calorimetric measurements of five nuclear fuel assemblies of the PWR 17 x 17 type are provided. Measurements of the temperature both inside a calorimeter, in which the fuel assembly was placed, as well as outside, were performed as a function of time while water circulating inside the calorimeter heats up from radiation emitted in the radioactive decay of material in the fuel assembly. The data contain also measurements of dose rate in the water outside the calorimeter. Data from 38 measurements using an electrically heated model of a fuel assembly are also provided to be used for, e.g., calibration.

The data can be used for validation of computer codes for modelling of nuclear systems, e.g. nuclear reactors, storage and transport of nuclear fuel or systems for geological disposal.

© 2019 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

* Corresponding author.
E-mail address: peter.jansson@physics.uu.se (P. Jansson).

https://doi.org/10.1016/j.dib.2019.104917

2352-3409/© 2019 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).
1. Data

Data are stored as Excel spreadsheets with one measurement of one fuel assembly per file. The name of the file indicates which fuel assembly that was measured and on which date it was measured. The first rows of the spreadsheet file contain Meta information about the measurement. Measurement data are stored in columns, with data from each measurement sensor in each column, and with the time of the measurement increasing downwards in the spreadsheet.

Burnup, cooling time and initial enrichment of U-235 of the measured fuel assemblies are listed below.
Data from the calibration measurements have the same structure as the measurements with nuclear fuel. The name of the file indicates that it is a calibration measurement if it begins with the word ‘EV’ and contains also the set electric power input as well as the measurement date.

Sensors named in the data, and what they are measuring, are listed as follows.

| Sensor name | Unit | Measurement |
|-------------|------|-------------|
| _251KA901_A_kW | Watt | Power input to the electrically heated model, if applicable. |
| _251KA09 | Degree C | Temperature difference between inlet and outlet of the circulation flow through the calorimeter. |
| _251KA501 | Degree C | Temperature of the water in the inlet to the calorimeter. |
| _251KA502 | Degree C | Temperature of the water in the outlet from the calorimeter. |
| _251KA511 | Degree C | Temperature of the water inside the calorimeter. |
| _251KA515 | Degree C | Temperature of the water inside the calorimeter. |
| _251KA516 | Degree C | Temperature of the water inside the calorimeter. |
| _251KA517 | Degree C | Temperature of the water inside the calorimeter. |
| _251KA518 | Degree C | Temperature of the water inside the calorimeter. |
| _251KA519 | Degree C | Temperature of the water inside the calorimeter. |
| _251KA751 | Kilogram | The weight of an external tank with water, used to monitor that the fuel is constantly cooled. |
| _251KA101 | Bar | The pressure in the inlet pipe to the calorimeter. |
| _251KA521 | Degree C | Temperature on the inside wall of the calorimeter. |
| _251KA531 | Degree C | Temperature in the pool outside the calorimeter. |
| _251KA532 | Degree C | Temperature in the pool outside the calorimeter. |
| _251KA701 | Gray/hour | Gamma dose rate outside the calorimeter. |
| _251KA702 | Gray/hour | Gamma dose rate outside the calorimeter. |
| _251KA703 | Gray/hour | Gamma dose rate outside the calorimeter. |
| _251KA704 | Gray/hour | Gamma dose rate outside the calorimeter. |
| _251KA705 | Gray/hour | Gamma dose rate outside the calorimeter. |
| _251EA1 | Watt | Power input to the whole system. |
| EA1_Borvarde | Watt | The setpoint of power consumption of the electrically heated model, if applicable. |
| _251KA901_B_PA | Watt | Power input to the water circulation pump. |

2. Experimental design, materials, and methods

Measurements where performed using the calorimeter described in more detail in Ref. [1]. Essentially, a closable stainless steel container (calorimeter) is used as a device to measure the increase
of the temperature inside the container. The data provided can be evaluated by, e.g., the methods described in Refs. [2,3]. Each measurement was performed as follows:

1. Place a nuclear fuel assembly in the calorimeter and close it.
2. Cool the water in the calorimeter down to a few degrees below the temperature of the surrounding pool water.
3. Stop cooling and let the decay heat produced by the nuclear fuel heat up the calorimeter.
4. During the whole time, measure the temperatures both inside and outside of the calorimeter as well as dose rate in the water outside.
5. When the temperature in calorimeter has increased beyond the pool temperature by several degrees, stop the measurement and remove the fuel assembly.

Acknowledgments

The personnel at the central interim storage for spent nuclear fuel (Clab) in Oskarshamn, Sweden, are acknowledged for their assistance in these measurements.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.104917.

References

[1] “Measurements of Decay Heat in Spent Nuclear Fuel at the Swedish Interim Storage Facility, Clab”, December 2006. SKB report R-05-62, https://www.skb.se/publikation/1472024/R-05-62.pdf.

[2] M. Bengtsson, P. Jansson, “KBP6001 - Methodology for Assessment of Calorimetric Measurement with the Temperature Rising Method”; SKB Document ID: 1629283, Version 3.0, April 2019. SKB documents will be submitted upon request to document@skb.se.

[3] P. Jansson, M. Bengtsson, “KBP6003 — Methodology for Uncertainty Analysis of Calorimetric Measurement with the Temperature Rising Method”; SKB Document ID: 1533630, Version 2.0, June 2019. SKB documents will be submitted upon request to document@skb.se.