

TAGS and FP Decay Heat Calculations () - Impact on the LOCA Condition Decay Heat -

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Brief Summary

Introducing the TAGS (Total Absorption Gamma-ray Spectrometer) data, the FP decay heat for Pu-239, Pu-241, U-235, and U-233 after one year irradiation have been calculated. In order to see the impact of TAGS data on LOCA (Loss of Coolant Accident) condition, those results were compared with the calculations based on the original data such as JENDL, JEF and ENDF/B-VI. It was concluded that the decay heat calculation introducing TAGS data does not exert any serious impact from a practical point of view.

WHAT IS TAGS?

A typical Total Absorption Gamma Ray Spectrometer⁽¹⁾ consists of a large scintillator having a deep axial well with the radioactive sample in it. In principle all of the γ -rays emitted in a cascade by the de-excitation of a certain level deposit all their energy in the scintillator. Therefore TAGS gives the level energy as the pulse energy and the β -feeding rate as the pulse height (Fig.1). The result is expected to be free from the level missing such as illustrated in Fig. 2.

A new series of experiments based on TAGS is scheduled on December at Jyvaskyla University by an European group in order to take the data for Tc isotopes, which are assumed to be the origin of the γ -ray discrepancy⁽³⁾ in the summation calculation.

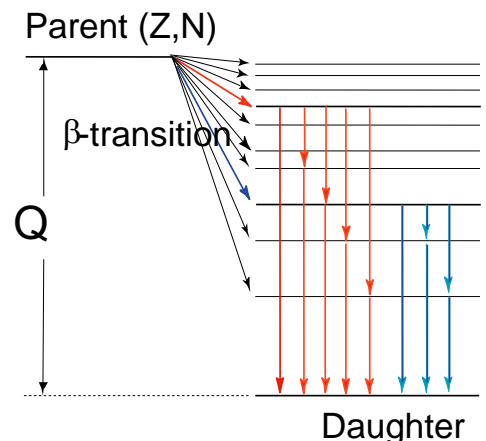


Fig.1 TAGS

(1) Greenwood et al, Nucl. Instr. And Meth., A 351 (1994) 406

(2) A. Algora, private communication (2004)

(3) T. Yoshida et al, Journal of Nuclear Science and Technology, 135 (1999) 142

Decay Heat Calculations and TAGS

In the case of JENDL and ENDF/B-VI the level missing in the high energy part had been theoretically compensated on the basis of the gross theory of β -decay. JEF is not corrected theoretically for the missing. It is, therefore, quite interesting to see the effect of introduction of TAGS data, which is expected to be free from missing of the β -strength, into the summation calculations based on these libraries.

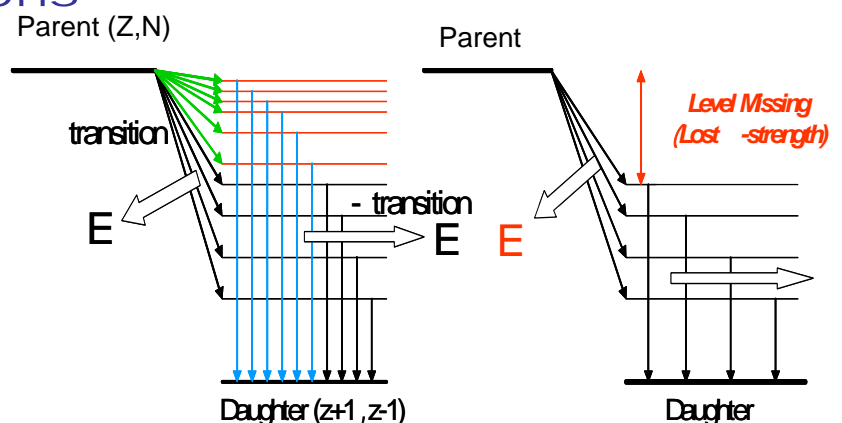


Fig.2 Missing of β -strengths

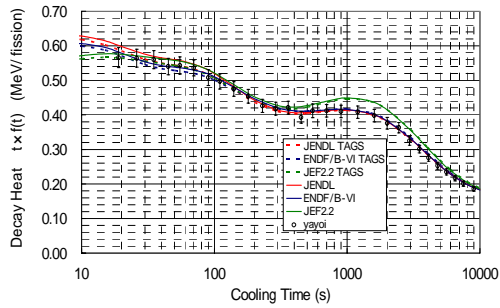


Fig.3 Decay Heat after a Burst Fission in Pu-239 β -ray Component, TAGS Effect

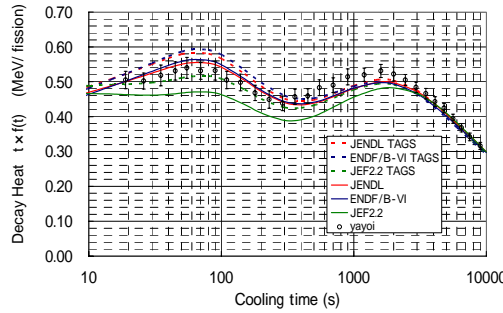


Fig.4 Decay heat after a Burst Fission in Pu-239 γ -ray Component, TAGS Effect

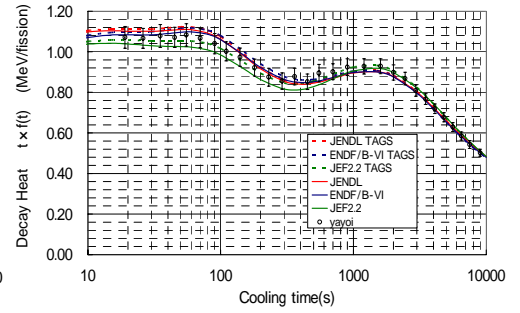


Fig.5 Decay Heat after a Burst Fission in Pu-239 β - and γ -component, TAGS Effect

Figures 3 and 4 show the β - and γ -ray component of the decay heat in Pu-239 after a burst fission. Figure 5 shows their sum. In the case of JEF, where any theoretical correction is not applied for the missing of the β -strengths, improvement by introducing the TAGS data is remarkable. On the other hand, as for JENDL, where the correction is applied on the basis of the gross theory, the very good agreement is no longer maintained. The γ -ray component is overestimated in the cooling time range from 30 to 300 seconds. But their sum (Fig. 4) maintains the agreement within the error bar.

Impact on The LOCA Condition Decay Heat

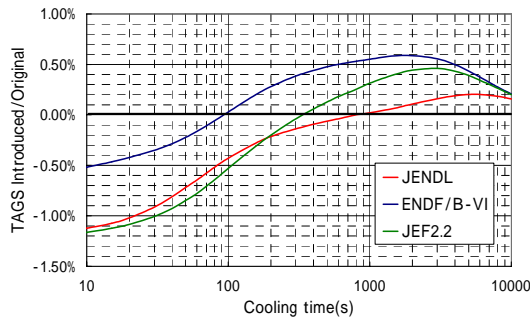


Fig.6 Effect of Introduction of TAGS Energies into Original Summation Calculation (Thermal Fission in Pu-239, β -ray Component)

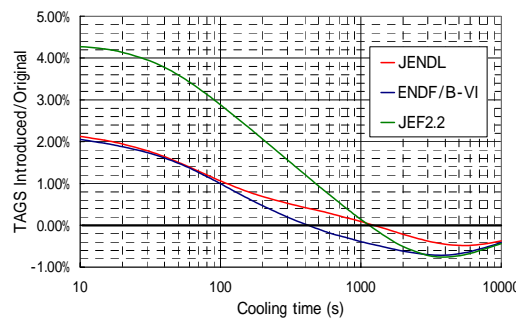


Fig.7 Effect of Introduction of TAGS Energies into Original Summation Calculation (Thermal Fission in Pu-239, γ -ray Component)

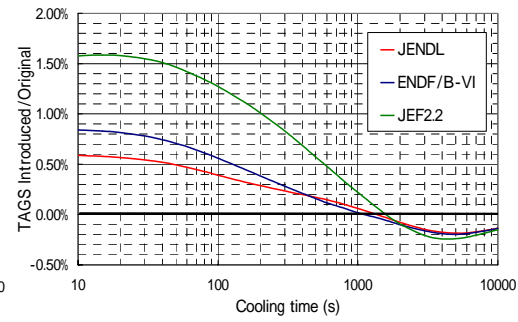


Fig.8 Effect of Introduction of TAGS Energies into Original Summation Calculation (Thermal Fission in Pu-239, Total Decay Heat or $\beta + \gamma$)

Figures 6, 7 and 8 show the impact of introduction of the TAGS data into the summation calculations for Pu-239 after one year irradiation. As far as the total decay heat is concerned (Fig.8), the effect is smaller than 0.6 % for JENDL.

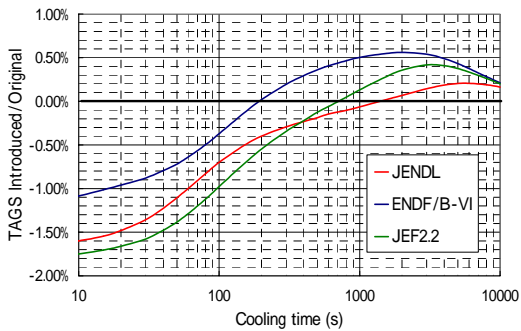


Fig.9 Effect of Introduction of TAGS Energies into Original Summation Calculation (Thermal Fission in U-235, β -ray Component)

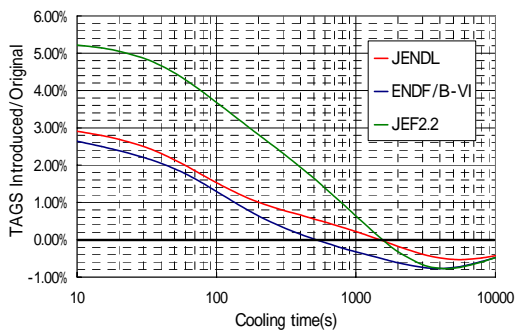


Fig.10 Effect of Introduction of TAGS Energies into Original Summation Calculation (Thermal Fission in U-235, γ -ray Component)

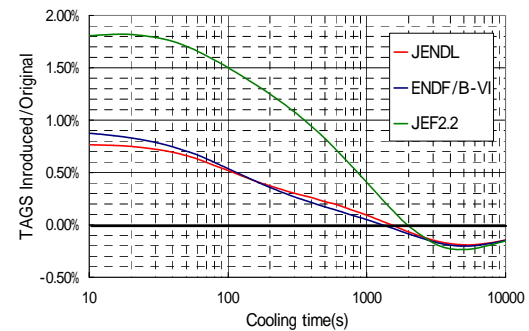


Fig.11 Effect of Introduction of TAGS Energies into Original Summation Calculation (Thermal Fission in U-235, Total Decay Heat or $\beta + \gamma$)

Figures 9, 10 and 11 show the impact of introduction of the TAGS data into the summation calculations for U-235 after one year irradiation. As far as the total decay heat is concerned (Fig.11), the effect is smaller than 0.8 % for JENDL.

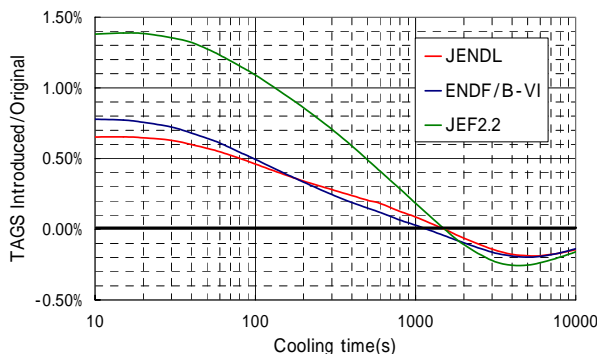


Fig.12 Effect of Introduction of TAGS Energies into Original Summation Calculation (Thermal Fission in Pu-241, Total Decay Heat or $\beta + \gamma$)

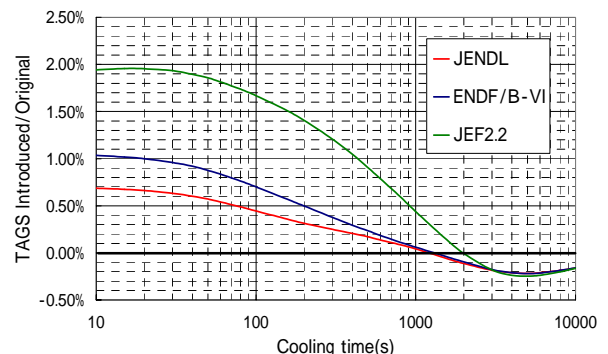


Fig.12 Effect of Introduction of TAGS Energies into Original Summation Calculation (Thermal Fission in U-233, Total Decay Heat or $\beta + \gamma$)