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Subgroup 20: Covariance Matrix Evaluation and Process in the Resolved/Unresolved Resonance Regions Status Report

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This report includes the activity of SG20 from April 2001 to April 2002. In this period our main task was to survey presently existent covariance data for each project, and to investigate various evaluation methods.

- Last year we had a side-meeting on those topics during ND2001, Tsukuba. An attached is a short-summary of the meeting.
- Another information on the covariance evaluation was from French group independently of the side-meeting. JEFF group is making covariances with SAMMY, and its report is internally circulated. They have a plan to publish their evaluation method, however this is not yet finalized.
- When resonance parameters are evaluated with SAMMY, the most appropriate solution of our task is to find covariance data files generated by SAMMY itself. This is the case for ^{235}U because those resonance parameters evaluated by Leal *et al.* of ORNL are widely used for many nuclear data libraries. Oak Ridge group announced that they still hold old data files, but they don't have an archive system so that it is hard to meet requests at this moment.
- JENDL group adopted a simple way to approximate covariances of resonance parameters. The method was reported at the side-meeting, and a paper was submitted to J. Nucl. Sci. Technol. this year with the following abstract:

  > A simple method to estimate covariances for resolved resonance parameters was developed. Although a large number of resolved resonances are observed for major actinides, uncertainties in averaged cross sections are more important than those in resonance parameters in reactor calculations. The method developed here is to derive a covariance matrix for the resolved resonance parameters which gives an appropriate uncertainty of the averaged cross sections. The method was adopted to evaluate the covariance data for ^{235}U, ^{238}U, and ^{239}Pu resonance parameters in JENDL-3.2, with the Reich-Moore R-matrix formula.

- To process a covariance data file (FILE32), a computer code ERRORJ was developed at JNC and Sumitomo Atomic Energy Industries Ltd. This program can be used as a NJOY module. We transfered this information to LANL. JNC announced that the ERRORJ code is available on request. Please contact to Dr.Ishikawa in JNC (ishikawa@oec.jnc.go.jp)

A short summary on WPEC/SG20 satellite meeting at ND2001

An overview of this group - WPEC/Subgroup 20 - was shown by T.Kawano. Our objectives are to develop methods of covariance evaluation in the resolved/unresolved resonance energy regions for important nuclides. Currently similar projects are going independently at each project, ENDF, JENDL, and JEFF. However the same resonance parameters obtained with a SAMMY analysis are often adopted for those

libraries. So that an evaluation of the covariance can be done under the international cooperation. What we need is a covariance file which can be processed with an existent code like NJOY.

N.M.Larson gave an outline of SAMMY which has been used for an analysis of ToF data since 1978. The code employs the Reich-Moore R-matrix theory to determine resonance parameters. Concerning the derivation of covariances, SAMMY treats an "Implicit Data Covariance Matrix" in which the data covariance is decomposed into a statistical part (diagonal) and an error propagation part from data reduction parameters which describe experimental conditions and those yield systematic errors (off-diagonal). The SAMMY code can be used for unresolved resonance parameters too. This part is basically the same as F.H.Fröhner's FITACS code. N.M.Larson also investigated how to reduce the size of covariance matrix.

A simple method to estimate covariance matrices for U and Pu in JENDL-3.2 was shown by T.Kawano. They calculated a covariance of resonance parameters which generates uncertainties in experimental averaged cross sections. This method is independent of the SAMMY analysis, and gives a rough estimation of error information of the cross sections in a resolved resonance region.

A computer code ERRORJ, which can be used as a module in the NJOY system, was developed at JNC and SAE. K.Kosako reported on this code. The code generates covariance of group-constants from the covariance of resonance parameters. An error propagation is calculated with a 1% sensitivity method, with which derivatives are calculated numerically.