Notes of a Meeting on Reactor Decay Heat

held at IPNO, Orsay, Paris on July 17th, 2006.

Participants:- A.Algora (IFIC, Valencia), F.Asaiez (IPNO), O.Bersillon (CEA, Bruyeres-le-Chatel), W.Gelletly(Surrey), D.Guilleamaud-Mueller (IPNO), H.Henriksson (OECD/NEA), F.Ibrahim (IPNO), R.Jacqmin (CEA,Cadarache), M.A.Kellett (IAEA), D.Lhuillier (CEA,Saclay), R.Mills (NEXIA), B.Rubio (IFIC,Valencia), J.-L.Tain (IFIC,Valencia)

Programme:- Following a brief welcome to IPNO by the Director, D.Guillemaud-Mueller, there were presentations in three general areas. Firstly M.Kellett and R.Mills introduced the various codes and data libraries on which calculations of decay heat are based. The uses of the codes, the underpinning decay data libraries and their philosophies were all discussed. Deficiencies in the data both as a function of time after reactor shutdown and in general were then discussed. They discussed the work of the NEA Working Party on international nuclear data Evaluation Cooperation (WPEC) sub-group 25 and the discrepancies between the calculations of decay heat for various fissioning species and measurements of decay heat after a single fission pulse. A list of nuclides whose beta decays need to be measured to remedy these deficiencies has been drawn up following two meetings over the previous six months. This list was presented.
This was followed by presentations by J.L.Tain and A.Algora of the Total Absorption (TAGS) technique and its relevance both to spectroscopic measurements and to studies of reactor decay heat. They reported some of the measurements made by the Valencia group using TAGS as well as the methods of analysis they have developed. In this context they reported the results of TAGS measurements of the decays of ^{104}Tc and ^{105}Tc the group had carried out at Jyvaskyla with the radioactive species being produced in proton-induced fission and extracted using the IGISOL system. These measurements, when included in either the JEFF or ENDF/B decay data libraries show a clear improvement in the agreement between the calculations and the measured decay heat of ^{239}Pu at a cooling time between 500 and 1000 seconds.
D.Lhuillier then presented the interests of the SUBATECH-Saclay group in using the antineutrino spectrum from power reactors as the basis for determining both the reactor power and the mixture of fissioning material in the operating reactor.
Finally F.Ibrahim reported on the characteristics of the ALTO facility and the progress made so far in achieving the operating specifications. The building programme has been very successful so far and many important milestones have already been reached. At this point the primary beams that can be used are limited in intensity because of safety considerations but this will slowly be increased with time and there is no reason to expect that the design goals cannot be reached. He then went on to describe the tape transport system and the stage of development that has been reached. The meeting ended with a technical visit to the ALTO facility.

Conclusions:- It was clear from the discussion during the presentations and at the end of the meeting that a) there is a problem to be addressed in terms of the deficiencies of the decay data libraries, b) the TAGS measurements can contribute to resolving the discrepancies, c) the ALTO facility can provide beams of the species of interest although it will take time before the beams are developed and d) there are also many experiments in nuclear spectroscopy and nuclear astrophysics that require the TAGS technique and could be carried out with profit at ALTO.

In the discussion it was agreed that

1) There is a strong prima facie case for proceeding to consider in detail how and where to deploy the BaF_2 spectrometer at ALTO. The meeting felt that this endeavour had a sufficiently strong case to obtain beam-time from the PAC.
2) The generic case for this programme of measurements should be presented to the next PAC, which will be held in the Spring of 2007. Assuming success, less detailed cases would then need to be made to the PAC in the future. This initial case should not only address the decay heat application but also associated problems in nuclear structure and astrophysics that might be tackled with the TAGS.
3) The experimental team would be led by J.L.Tain and would be driven by him and A.Algora. The former would be the primary point of contact [Tain@ific.uv.es] for the laboratory and any potential collaborators.
4) The IPN Laboratory agreed that they would be able to provide engineering and technical help to establish the apparatus at ALTO. In particular they would be able to help to couple the tape system to the TAGS spectrometer.