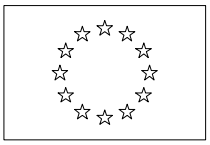

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Final Report of the n_TOF-ND-ADS Project
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EURATOM FP5 Project
n_TOF-ND-ADS

Contract No. FIKW-CT-2000-00107

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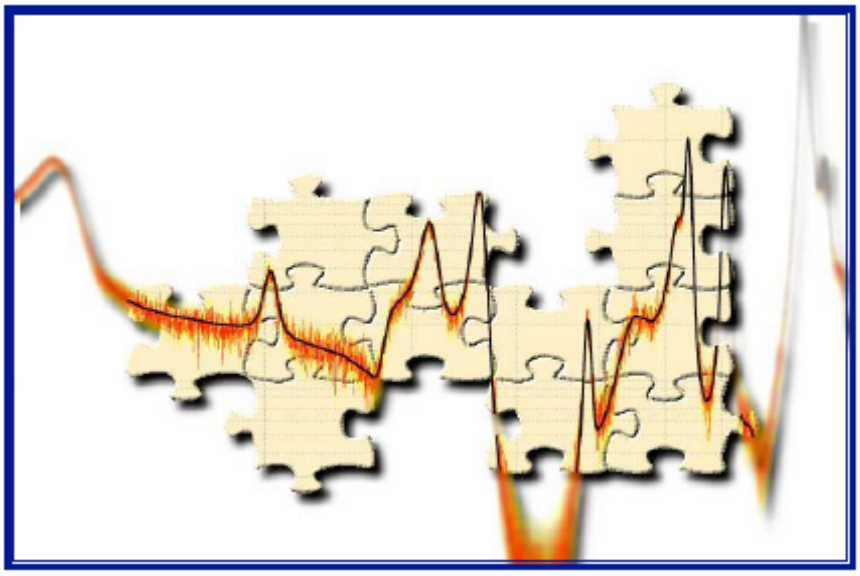

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Executive Summary

The design of innovative accelerator driven systems (ADS) for incineration of nuclear waste and energy generation requires the complete knowledge of basic cross sections for neutron induced processes. For design purposes, these data need to be derived in a consistent, accurate and cost-effective way, to be evaluated and made available in a way compatible with simulation tools and industry practices in general. The main goal of the n_TOF-ND-ADS Project has been to produce and disseminate high precision cross section data for the majority of the isotopes relevant to the waste incineration and the ADS design. This included capture and fission cross sections for the minor actinides, capture cross sections for the main fission products and (n,xn) reactions for structural and coolant materials. These objectives have been obtained by using three core technologies: an innovative high-energy spallation source built at CERN (the CERN n_TOF facility), high performance detectors and DAQ systems, and state-of-the-art computer engineering.

In this report, a description of the design studies, the realization, and performances of the CERN neutron time-of-flight facility is given together with an overview of all the experimental devices developed for measurements of high-resolution neutron cross section data. A brief account of all the measurements performed at n_TOF in its commissioning phase and in the three experimental campaigns performed in 2002, 2003 and 2004 is given.

The full list of the isotopes for which the neutron cross section measurements have been performed at n_TOF in the framework of the n_TOF-ND-ADS Project is the following:

Capture

^{151}Sm
^{204,206,207,208}Pb, ^{209}Bi
^{232}Th
^{24,25,26}Mg
^{90,91,92,94,96}Zr, ^{93}Zr
^{139}La
^{233,234}U
^{237}Np,^{240}Pu,^{243}Am

Fission

^{233,234,235,236,238}U
^{232}Th
^{209}Bi
^{237}Np
^{241,243}Am, ^{245}Cm

In addition to the n_TOF facility at CERN, facilities already available in Europe have been used for relevant measurements. These facilities included the Institute for Reference Material and Measurements of the Joint Research Center at Geel (Belgium), the Van de Graaff accelerator facility of the Forschungszentrum Karlsruhe (Germany), the Demokritos facility at the National Center of Scientific Research in Athens (Greece), and the Laboratório de Instrumentação e Física Experimental de Partículas at the University of Coimbra (Portugal). Activities performed at these facilities within the framework of the n_TOF-ND-ADS Project included measurements of neutron induced cross sections data and related detector developments, an account of which is presented here.

A description of the nuclear data evaluation tools developed within the framework of the Project and a description of the software platform for the dissemination of the results of the measurements is presented.

The n_TOF-ND-ADS Project involved the direct participation of 16 European research establishments. In addition, a collaboration (“The n_TOF Collaboration”) involving 41

research teams and over 120 researchers has been established around the Project's activities. The teams included participants from the USA and Japan as well as Europeans.

The n_TOF-ND-ADS Project has been an integral part of the BASTRA ("basic studies for transmutation") cluster activities. BASTRA included, in addition to n_TOF-ND-ADS, the HINDAS ("high and intermediate energy nuclear data for accelerator-driven systems"), and the MUSE ("multiplication avec sources externes"). The activity of this cluster spans from experiments devoted to the understanding of the neutronics of sub-critical systems to high-accuracy measurements of neutron cross sections for long-lived fission products and minor actinides as well as the development of reliable nuclear reaction models for the description of high-energy spallation processes, and the generation and dissemination of evaluated nuclear data libraries.