SEVENTH FRAMEWORK PROGRAMME
THEME [FP7 – Fission WP2009]
[Nuclear Fission and Radiation Protection]

Grant agreement for: Small or medium-scale focused Collaborative Project (CP-FP)

Annex I - “Description of Work”

Project acronym: ANDES

Project full title: Accurate Nuclear Data for nuclear Energy Sustainability

Grant agreement no.: FP7 - 249671

Date of preparation of Annex I (latest version): May 5th, 2010

Date of approval of Annex I by Commission:

List of Beneficiaries

Beneficiary Number *	Beneficiary name	Beneficiary short name	Country	Date enter project**	Date exit project**
1(coordinator)	CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS	CIEMAT	Spain	1	36
2	COMMISSARIAT A L' ENERGIE ATOMIQUE	CEA	France	1	36
3	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE	CNRS	France	1	36
4	GESELLSCHAFT FUER SCHWERIONENFORSCHUNG Gmbh	GSI	Germany	1	36
5	INSTITUTUL NATIONAL DE CERCETARE - DEZVOLTARE PENTRU FIZICA SI INGINERIE NUCLEARA "HORIA HULUBEI"	IFIN-HH	Romania	1	36
6	ISTITUTO NAZIONALE DI FISICA NUCLEARE	INFN	Italy	1	36
7	INSTITUTO TECNOLOGICO E NUCLEAR	ITN	Portugal	1	36
8	COMMISSION OF THE EUROPEAN COMMUNITIES – DIRECTORATE GENERAL JOINT RESEARCH CENTRE	JRC-IRMM	EU	1	36
9	INSTITUT JOZEF STEFAN	JSI	Slovenia	1	36
10	JYVASKYLAN YLIOPISTO	JYU	Finland	1	36
11	NATIONAL NUCLEAR LABORATORY LIMITED	NNL	U. K.	1	36
12	NUCLEAR RESEARCH AND CONSULTANCY GROUP	NRG	Netherlands	1	36
13	PAUL SCHERRER INSTITUT	PSI	Switzerland	1	36
14	STUDIECENTRUM VOOR KERNENERGIE	SCK-CEN	Belgium	1	36
15	TECHNISCHE UNIVERSITAET WIEN	TUW	Austria	1	36
16	UNIVERSITATEA DIN BUCURESTI	UB	Romania	1	36
17	UNIVERSITE DE LIEGE	ULG	Belgium	1	36
18	UNIVERSIDAD POLITECNICA DE MADRID	UPM	Spain	1	36
19	UNIVERSIDADE DE SANTIAGO DE COMPOSTELA	USC	Spain	1	36
20	UPPSALA UNIVERSITET	UU	Sweden	1	36

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Part A

A 1. Budget breakdown form (copy of A3.2 form of the GPFs)

A3.2:
What it costs

Project Number	249671	Project Acronym	ANDES

Participant number in this project	Participant short name	Estimated eligible costs (whole duration of the project)					Total receips	Requested EC Contribution
		RTD/ Innovation (A)	Demonstration (B)	Management (C)	Other (D)	Total A+B+C+D		
1	CIEMAT	480,000.00	0.00	31,000.00	119,000.00	630,000.00	0.00	390,000.00
2	CEA	1,170,000.00	0.00	7,500.00	7,500.00	1,185,000.00	0.00	600,000.00
3	CNRS	966,576.32	0.00	0.00	0.00	966,576.32	0.00	285,000.00
4	GSI	150,000.00	0.00	0.00	0.00	150,000.00	0.00	75,000.00
5	IFIN-HH	140,000.40	0.00	0.00	0.00	140,000.40	0.00	70,000.00
6	INFN	240,000.00	0.00	0.00	0.00	240,000.00	0.00	120,000.00
7	ITN	80,000.00	0.00	0.00	0.00	80,000.00	0.00	40,000.00
8	JRC	539,840.00	0.00	0.00	15,080.00	554,920.00	0.00	285,000.00
9	JSI	150,000.00	0.00	0.00	0.00	150,000.00	0.00	75,000.00
10	JYU	120,000.00	0.00	0.00	0.00	120,000.00	0.00	60,000.00
11	NNL	180,000.00	0.00	0.00	0.00	180,000.00	0.00	90,000.00
12	NRG	460,000.00	0.00	10,000.00	15,000.00	485,000.00	0.00	255,000.00
13	PSI	170,000.40	0.00	0.00	0.00	170,000.40	0.00	85,000.00
14	SCK	150,000.00	0.00	0.00	0.00	150,000.00	0.00	75,000.00
15	TUW	170,000.00	0.00	0.00	0.00	170,000.00	0.00	85,000.00
16	UB	100,000.00	0.00	0.00	0.00	100,000.00	0.00	50,000.00
17	ULG	150,000.00	0.00	0.00	0.00	150,000.00	0.00	75,000.00
18	UPM	240,000.00	0.00	0.00	0.00	240,000.00	0.00	120,000.00
19	USC	180,000.00	0.00	0.00	0.00	180,000.00	0.00	90,000.00
20	UU	90,000.00	0.00	0.00	34,000.00	124,000.00	0.00	70,000.00
TOTAL		5,926,417.12	0.00	48,500.00	190,580.00	6,165,497.12	0.00	2,995,000.00

A 2. Project summary form (copy of A1 form of the GPFs)

A1:
Our project

Project Number [1]	249671	Project Acronym [2]	ANDES

One form per project

General information			
Project title [3]	Accurate Nuclear Data for nuclear Energy Sustainability		
Starting date [4]	First day of the month following the signature of the Grant Agreement		
Duration in months [5]	36		
Call (part) identifier [6]	FP7-Fission-2009		
Activity code(s) most relevant to your topic [7]	Fission-2009-2.3.2: Improved nuclear data for advanced reactor systems		
Free keywords [8]		Nuclear Data Fast Reactor Actinides Covariances Measurements Evaluation Validation Sustainability ADS Transmutation	

Abstract [9] (max. 2000 char.)

According to the recent publications of the European Technological Platform for a Sustainable Nuclear Energy (SNETP) (Vision report and Strategic Research Agenda) the sustainability require the combination of the present LWR, future Advanced Fast reactors and the waste minimization in closed cycles with Partitioning and Transmutation. To implement these new nuclear systems and their fuel cycles it is necessary to improve the accuracy, uncertainties and validation of related nuclear data and models, required for those systems but also for the experimental and demonstration facilities involved in the their validation. The project will include new nuclear data measurements, dedicated benchmarks, based on integral experiments, and improved evaluation and modeling specifically oriented to obtain high precision nuclear data for the major actinides present in advanced reactor fuels, to reduce uncertainties in new isotopes in closed cycles with waste minimisation and to better assess the uncertainties and correlations in their evaluation.

A 3. List of beneficiaries

Beneficiary Number *	Beneficiary name	Beneficiary short name	Country	Date enter project**	Date exit project**
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Part B

B 1. Concept and objectives, progress beyond state-of-the-art, S/T methodology and work plan

B 1.1. Concept and project objective(s)

Nuclear Fission is a key source of energy for electricity production, representing about 30% of the generation in Europe. The need to reduce the dependence on the fossil sources of energy because of their impact on the global world climate, and the competitiveness of electricity from nuclear generation are attracting new large emerging countries and confirming the future dependence of the world largest economies in the nuclear energy. However this scenario highlights the need of improved sustainability for the nuclear energy produced by fission. The EU SET plan [1] has acknowledged this role of nuclear energy and the need to improve its sustainability. In order to reply to these needs a wide group of utilities, industries, research centers, universities and other actors created the European Technological Platform for Sustainable Nuclear Energy, SNETP, in 2007. First, the vision report and more recently the Strategic Research Agenda (SRA) [2] of the SNETP identify three topics as the key technological pieces for the sustainability: the optimization of the use of natural resources (particularly Uranium), the minimization of final high level wastes and the economical competitiveness at present and at future. To optimize these three pillars and making reference to the conclusions of several FP6 projects like PATEROS, RED-Impact, EUROTRANS and the analysis of NEA and IAEA expert groups, the SRA proposes the use of advanced closed fuel cycles, which combine at short term evolutionary Light Water Reactors (LWR) with fast spectrum nuclear system (Generation IV Fast Reactors (FR) Accelerator Driven subcritical Systems, ADS) and advanced Partitioning and Transmutation technologies, at medium and long term.

The successful development of advanced nuclear systems for sustainable energy production depends on high-level modeling capabilities for the reliable and cost-effective design and safety assessment of such systems, and for the interpretation of key benchmark experiments needed for performance and safety evaluations. High-quality nuclear data, in particular complete and accurate information about the nuclear reactions taking place in advanced reactors and the fuel cycle, are an essential component of such modeling capabilities. A primary benefit of improved nuclear data lies in the perspective of cost reductions in developing and operating nuclear reactors; with precise nuclear data, nuclear systems can be designed to reach high efficiencies whilst maintaining adequate safety standards in a cost-effective manner. Indeed the SRA indicates improving and completing the basic data as a necessary element to achieve the required level of prediction of the present and future simulation tools.

The challenge comes from two different directions. First there are the new elements: new fuels with large contents of Pu and minor actinides in Gen IV FR, ADS, and Gen III(+) reactors, new coolants and structural materials, new spectra, closed fuel cycles with multiple recycling that enhance the uncertainties of the predicted fuel composition and associated manipulation conditions, the need to consider very high energy nuclear reactions in the ADS, and others. The second aspect is related to the new applications of the simulation tools that will require a better precision and a more realistic assessment of this precision. In this sense, there are the requirements of best estimate codes to optimize even the preliminary designs of the new reactors, the tendency to minimize the costly and lengthy validation of concepts in experimental and demonstration reactors, and the need of early selection of fuel cycle and reactor options (to accelerate the development path) on the basis of predicted performance and impact of the long term consequences on the fuel cycle. A specific example is the intention of several large research centers to select the preferred fast nuclear systems in less than 10 years, when some of the systems under consideration will not be tested with their final fuel.

To achieve the required level of accuracy and reliability it is necessary to combine different types of actions: the improvement of basic measurements of the cross sections of critical reactions of selected isotopes; the generalized introduction of realistic and complete uncertainties and covariance matrices for the nuclear data used in the simulations and the generalization of the uncertainties propagation in the reactor and fuel cycle simulations; the validation of basic data and their uncertainties using integral experiments, including the possible identification of feedback to the data evaluation to reach the compatibility with these experiments; the validation and improvement of the high energy reaction modeling, to achieve the level of precision and details reached in the recent differential and integral experiments related to spallation neutron sources; and finally the dissemination of this information to the nuclear data bases and to the End-Users, both industrial designers as well as research centers and universities that will complete the integration and validation of the abovementioned progress.

The objective of the ANDES project will be to develop a program of specifically targeted actions to address these most critical points of the knowledge of nuclear data for its application to the development of the new nuclear systems and their fuel cycles required to enhance the nuclear energy sustainability, with the aim of achieving significant improvements on the simulation capacity for the European nuclear industry and supporting research, remaining realistically coherent with the available resources.

For the selection of the specific actions of nuclear data developments, ANDES has been guided by recent sensitivity studies performed by the working party on evaluation cooperation of the OECD Nuclear Energy Agency [4] and by the NUDATRA domain of IP-EUROTRANS [5]. These studies have as starting point target uncertainties of key reactor and fuel cycle parameters. In particular, they derive from these engineering requirements the corresponding target uncertainties for the nuclear data. Comparing these target uncertainties with the currently achieved uncertainties for the nuclear data led to a list of priorities that may be consulted through the OECD/NEA High priority request list for nuclear data [3] or the above-mentioned report [4]. In summary, a number of rather tight uncertainty requirements for nuclear data remain and these must be addressed if systems modeling is to be improved according to the needs of reactor systems modeling. It must be noted that in view of the difficulty associated with meeting the needs of the individual nuclear data priorities, substantial efforts are required for each of them, and one project like ANDES cannot deal with all of them. In addition, for substantial improvements, a more comprehensive, integrated approach to uncertainties and covariances is required and a better integration with and feedback from benchmark analyses is essential. For ANDES, the selection has taken into account the conclusions of the international studies and the experience of the participating teams:

- The NUDATRA DOMAIN of IP-EUROTRANS that combines measurements, evaluations, benchmarks and modeling activities at low and high energies. This project has allowed to master the most advanced techniques and to validate the measuring facilities. In addition methods for uncertainties propagation and sensitivity analysis in the simulation of multi-recycling fuel cycles have been developed allowing to identify the most relevant data needs.
- JRC-IRMM and n-TOF experimental facilities and experimental teams, that used in a combined way constitute arguably the best world quality experimental facilities for precision cross section measurements at low energy.
- Experience of European teams for measurement, interpretation and utilization of the results from the communities of previous EC supported projects IP-EUROTRANS (NUDATRA), EUFRAT, CANDIDE, EFNUDAT, NUDAME, nTOF_ND_ADS and HINDAS.
- Dissemination and training experience from the same collectivities that have systematically succeeded in the integration of their results in the international data bases, a high rate of scientific publications in refereed journals an participation in international workshops and in the finalization of PhD and Master Thesis from the activities in those projects.

In the aforesaid fora there has been an extensive participation of members of the ANDES project. This warrants the integration of the new project on the corresponding R&D roadmaps as well as in the standard data distribution mechanism of NEA/OECD and IAEA. Finally, the integration of groups from key facilities in the project will facilitate using EUFRAT and EFNUDAT support to facilities and visiting teams to the experimental activities included in the project.

To identify the most useful realistic set of differential measurements the conclusions of the above-mentioned sensitivity studies have been used. They show a number of very tight target uncertainties for nuclear data that are currently not achieved. It is generally recognized that these are often at the limit of what is achievable. In many cases nuclear modeling capabilities are inadequate to reach such low uncertainties and measurements are indispensable to guide model improvements. To achieve accurate results from measurements, on the one hand great care must be taken to control all aspects that affect the final result and on the other hand several independent results of comparable accuracy are required to assess that systematic effects are under control. Therefore, ANDES strives for a certain degree of redundancy in order to obtain convincing evidence for improvement of measurement uncertainty for a number of the specific objectives.

The specific objectives for differential measurements within ANDES concentrate on measurements of inelastic, capture and fission cross sections for priority isotopes, as identified by the sensitivity studies. The measurements for inelastic scattering concern the very important cases of ^{238}U and ^{23}Na, ^{90}Zr cross sections and assessment and quantification of the achieved uncertainties and covariances for ^{56}Fe, ^{28}Si and ^{24}Mg and the lead isotopes. The capture measurements concern ^{238}U and ^{241}Am. The ^{238}U capture cross section is an important reference for fast reactors warranting explicit experimental justification of the uncertainty in the range from 1 keV to 100 keV. The capture cross section of ^{241}Am was shown to be of importance for the accuracy of the fuel composition at discharge. For fission cross sections new experimental results will be obtained for ^{240,242}Pu, ^{243}Am, ^{245}Cm by direct neutron-induced fission and by surrogate neutron induced fission for ^{238}Pu using the transfer reaction ^{237}Np(^{3}He,pf). The target uncertainties for these fission reactions are very tight.

While preparing for these differential measurements ANDES will also aim at 1) developing techniques that may be used to obtain experimental results for Cm capture reactions for which at present very little is known, 2) improving estimates of decay heat and delayed neutrons for fast neutron induced fission.

The adequate determination of safety and economical margins of nuclear systems relies directly on the uncertainties of nuclear data. Therefore, one major objective of the project is to enhance the European capability to produce covariance data for isotopes which are important for advanced reactors, as identified from the sensitivity studies on GEN-IV systems and ADS. These covariance data need to be complete and reliable. First, completeness of nuclear data, including covariance data, can now be provided by the latest nuclear model codes. These nuclear model based covariance data will be merged with the covariance information of the experimental data. The most important actinides will be subjected to the newly developed covariance methods. In addition to nuclear reaction data, radioactive decay and fission yield data also need to be accompanied with associated covariance data. Finally, all these covariance data will be used in adapted processing and reactor/fuel cycle codes to calculate the impact on the most important parameters for advanced reactors and ADS, and their corresponding fuel cycles.

From the point of view of accuracy and reliability, the request of the End-Users of nuclear data is to have the capability to calculate neutronic behavior of the reactor core with uncertainties that meet the target accuracies needed for new reactor concepts such as the GEN-IV reactors, which should be optimized regarding safety, performance and waste minimization. The final uncertainties in the reactor calculation schemes come from different sources: biases in the modeling of the reactor within a particular code system, biases in the knowledge of the technological description of the reactor, and biases and uncertainties in the knowledge of nuclear data. The aim of the project in this context is to provide a set of representative integral experiments for GEN-IV systems and ADS for nuclear data validation; to develop on a common methodology to analyze these experiments; to be able to demonstrate the improvement in the overall accuracy in the system simulations due to the new evaluation of nuclear data and covariances prepared by the project; and finally to provide trends for nuclear data improvement for the type of reactors covered by the chosen experiments.

One of the most studied options for nuclear waste minimization in the EU is the transmutation of minor actinides (MA) in dedicated reactors, in particular with an ADS. Because of its sub-criticality, an ADS can, in principle, accommodate large fractions of MA, which would be unacceptable in critical reactors because of the deterioration of the safety parameters. An ADS demonstration facility, the MYRRHA/XT-ADS project, is under development in Europe. It consists of a proton accelerator delivering a 600 MeV - 2.5 mA or 350 MeV - 5 mA proton beam to a liquid Pb-Bi spallation target. ADS feasibility studies require the optimization of the spallation target for such a facility, the assessment of the radioprotection and material damage problems related to high-energy reactions and the reduction of the safety margins. All this demands for simulation tools validated in the energy domain of the demonstration facility and a quantitative estimation of their predicting capabilities. Simulation tools for ADS are high-energy transport codes in which the elementary interaction cross-sections and characteristics of all produced particles are calculated by nuclear-physics models down to 150 MeV and read from an evaluated nuclear-data file below. While there has been an important effort in the last years to collect high-quality experimental data and improve the predicting capabilities of high-energy models around 1 GeV, little has been done between 150 and 600 MeV. This energy domain is the most relevant for the ADS demonstrator, as well as for the last stages of the spallation cascade in the industrial ADS. Therefore the ANDES project will focus on the validation of the high-energy nuclear models used in transport codes in this energy domain. The goal is first to assess and then to improve their predicting capabilities, with emphasis on the most quantities important for the ADS demonstrator, such as the target radioactivity, the gas production (tritium, helium and volatile radioactive elements produced in the liquid metal target), or the damage in the surrounding structural materials. Because there are still inconsistent or missing appropriate experimental data in the energy domain, a few specific experiments, focused on measurements of clear relevance for model validation, will be performed.

Dissemination and training are key elements for the fast incorporation of the proposed technologies in the new nuclear projects. Specific actions will be setup in collaboration with the NEA/OECD and IAEA international nuclear data libraries distribution centers to accelerate the availability of the ANDES results. Furthermore, an End-Users group will be created and financially supported to allow universities, research centers, utilities and industries to get early information and access to the new data and the corresponding impact in the modeling and evaluation of nuclear systems.

B 1.2. Progress beyond the state of the art

The ANDES project has been organized to efficiently provide significant progress in all the steps of the nuclear data life cycle: measurements, evaluation, validation, utilization, dissemination and feedback. A selected realistic number of the most important pending problems is addressed to reduce the contribution of nuclear data to uncertainties in the prediction and estimation of key reactor and fuel cycle systems parameters that are related to safety of operation and sustainability of nuclear energy. Such progress will help to improve the understanding of benchmark experiments and tests with pilot plants and will therefore allow a more efficient, and thus less costly, research and development trajectory for the introduction of advanced reactors and their associated fuel cycles. To be effective the topics tackled by ANDES are guided by recent studies of expert groups that identified the main nuclear data contributing to the uncertainties of parameters of interest to system engineers. Thus, progress will be sought in areas that are of main interest.

More in detail, significant progress in the inelastic scattering, capture and fission cross sections will result for several important isotopes from the measurements proposed in ANDES. Due to the specific selection of isotopes and reactions to be measured in ANDES these results will be of primary interest in reducing uncertainties in the estimates for the multiplication factor at start of irradiation, of the void coefficient and of certain problems with estimates of peak power and end-of-irradiation nuclide densities (for more details on impact of the measurements see section IV.1). All these cross section measurements concern reactions for which the current nuclear data uncertainty is significantly larger than that necessary to satisfy the targets of modelling uncertainties established by systems engineers. Therefore, the emphasis for the measurement efforts will be on reducing experimental uncertainty and to quantify the covariances and limits of the techniques employed. In particular, attention will be paid to systematic effects that impact the measurement results.

For key reactions this implies comparing measurement results obtained at different facilities with different state-of-the-art setups in order to obtain the best possible understanding of systematic effects. For inelastic scattering relatively little accurate experimental results were published and therefore a substantial amount of data will result from the project for the important cases of ^{238}U, ^{23}Na, ^{56}Fe, ^{28}Si and Zr. For capture, new methods and setups were recently developed that warrant improved accuracy of the new proposed experiments for ^{238}U and ^{241}Am. Thus a substantial step towards meeting the target uncertainties for these reactions is anticipated. Similarly, recent progress in equipment and methodology development warrants important new experimental results for neutron-induced fission cross sections of ^{240,242}Pu, ^{243}Am and ^{245}Cm by the direct technique and the very difficult case of ^{238}Pu by surrogate neutrons. Here too, a joint effort of different experimental groups at a number of facilities is expected to result in a better understanding of systematic effects and how to deal with them, and from that more reliable and therefore improved uncertainty and covariance statements can be made. As a second point, two measurements are contributed to ANDES that explore the usefulness of surrogate neutrons to address questions that are currently beyond reach of experiments using neutrons directly. The first question concerns neutron capture cross sections for Cm isotopes. The applicability of this method to determine neutron-induced capture cross sections for an isotope of Cm will be explored for the first time. This is well justified, since little is known about such capture reactions, despite their importance for the spent fuel composition and safety aspects. The feasibility will be studied of determining fast neutron-induced fission yields for Np, Pu and Cm by applying for the first time the combination of surrogate neutrons and inverse kinematics with the VAMOS spectrometer at GANIL. Such fission yields would be unique, and contribute substantially to improving decay heat and delayed neutron estimates for advanced fast reactors (spent) fuel. As a final third point two measurements of decay data are contributed. For reactor and fuel cycle considerations fission product decay heat is important and a number of recently established deficiencies for gamma and beta heating will be tackled with state-of-the-art technology.

The importance of uncertainty data for nuclear safety and economy has recently been revived with sensitivity studies for GEN-IV reactors and ADS. The nuclear data covariance sets used for this stem from an Argonne-coordinated effort called BOLNA (a collaboration between Brookhaven, Oak Ridge, Los Alamos, NRG and Argonne), which was considered as a reasonable, though not sufficient, starting point for the determination of reactor and fuel cycle parameter uncertainties. Through the ANDES project, all nuclear data important for reactor and fuel cycle calculations will be accompanied by consistent covariance data. Much of this development will revolve around the European code system TALYS, which is now used all over the world for nuclear analyses. Its full power will be unleashed to provide a more reliable starting point for calculations on future nuclear energy systems. Old covariance data for actinides will be replaced by those coming from innovative Monte Carlo methods. In total, covariance data will be delivered for nuclear reaction, activation, decay and fission yield data. Moreover, reactor and fuel cycle software will be adapted to put these data into practice. Then, it will be possible to make much more reliable statements on important reactor quantities, such as e.g. subcriticality levels of an ADS, and the associated requirements (and costs!) of the accelerator. Also, credible uncertainty ranges for GEN-IV systems can be provided, enabling a better comparison of reactor calculations with industrial target accuracies. Finally, this will give better feedback for basic measurements.

In the last five years, the increased use of Monte Carlo codes to analyze the neutronic experiments, and the improvement of deterministic codes has allowed the reactor physic community to show the importance of the nuclear data uncertainties in the final accuracy of the results on all the physical quantities of interest for reactor characterization (see last report of SG26 of WPEC). At the same time a lot of experiments have been published in international databases like ICSBEP and IRPHE

(OECD). A consensus on the importance of such smart experiments to improve the accuracy and the knowledge of nuclear data is now adopted and has to be shared between the reactor physics and nuclear data community.

Another field of interest is the use of the sensitivities analysis of these experiments to provide trends on nuclear data improvements. Different calculation tools are available to perform these sensitivity calculations. One aim is to perform this analysis for different experiments. The experimental values that are used are complementary such as spectral indices, reactivity coefficients, and chemical analysis of isotopic depletion concentration. Moreover the use of calculation tools will ensure the quality of the nuclear data trends that will be provided. Finally this will give first, a better understanding of the impact of the nuclear data on the reactor physic analysis; and second abetter understanding of the demands made by the reactor physics and the nuclear data communities.

Recent large efforts in collecting high quality data for ADS design have led to a significant improvement in the predicting capabilities of the simulation tools (the INCL4/ABLA code system) for spallation targets using protons with energy above 650 MeV. These efforts were contributed the HINDAS and EUROTRANS/NUDATRA EC projects. However, remaining differences between the INCL4/ABLA calculations and the experimental data are still not acceptable in many cases and little has been done concerning model validation in the 150-600 MeV energy domain, which is of interest to foreseen research and demonstrator facilities. The main model deficiencies in the latter energy domain will be drawn up capitalizing on an ongoing IAEA benchmark of spallation models and by extending it to include additional comparisons to existing data in this energy domain. This will allow identifying the main deficiencies of the models that should be corrected. As regards the experimental data, there are sometimes inconsistencies between different sets of data as well as gaps that prevent model validation. This concerns in particular the production yields of fragments in p+Pb at 500 MeV, which are important for the assessment of the radioactivity released by volatile elements from the liquid metal target. The SPALADIN experiment which will be performed at GSI during this project will allow answering this question and in addition provide data on intermediate mass fragment and helium production at 500 MeV, where such data are scarce.

The production of tritium in the spallation target, due to both primary proton and secondary neutron induced reactions, is a major problem for radioprotection but only few data exists below 600 MeV. In this project, neutron induced light-ion production (including tritium and helium) from Fe, Bi and U at 175 MeV will be measured at Uppsala, providing very useful data at an energy corresponding to the low-energy limit of models and high-energy limit of evaluated data files. Model improvements will target the identified deficiencies having an impact on the prediction of key parameters of ADS demonstrators and the resulting uncertainty reduction will be quantified. Integral validation of the models implemented into transport codes is also necessary. In this project, samples from the MEGAPIE target (the first liquid lead-bismuth spallation target irradiated by a 575 MeV proton beam successfully during 4 months) will be analyzed. The investigation will focus on the analysis by radiochemical techniques of long-lived ß- or EC-emitters and a-active isotopes of Po which are mostly originating from bismuth and are a major problem for radioprotection. The improved codes will finally be compared to these and existing complementary data.

The dissemination and training activities, particularly the continuous information to the End-Users group will help accelerating the access and penetration of the new results in the form of new data bases, new uncertainty and covariance information and new methods to use these data. In addition the training activities both in the form of PhD and Master thesis and training courses will be focused to prepare new scientist and engineers able to continue this type of development in the future.

B 1.3. S/T methodology and associated work plan

B 1.3.1. Overall strategy and general description

The ANDES project will be organized to efficiently provide significant progress in all the steps of the nuclear data life cycle (measurements, evaluation, dissemination, validation, utilization and feedbacks), and to address a selected realistic number of the most important pending problems. Namely the main objective will be to improve the accuracy, prediction capability and the assessment of this accuracy for: the simulation of reactors (Gen III(+) and Gen IV) and fuel cycles based in the Uranium fuels; the simulation of advanced closed fuel cycles with multiple recycling; the modeling of high energy models valid for demonstrators as well as for the final industrial ADS. A particular effort will be devoted to a general improvement on the uncertainties and covariances and the way to use them.

Following the type of activities and the coherence between teams, the activities will be organized into four technical work packages related with differential measurements, evaluation and uncertainties, integral validation and high energy models and experiments. The work package coordinators have been chosen for their known expertise in the field of their work package but also for their broad view on all the aspects of nuclear data. This will ensure a good management of the complementarities and the transfer of results between the different work packages.

Taking into account that the dissemination and training activities, particularly the continuous information to the End-Users group, are the elements for a successful penetration of the new results and methods at present and their future improvements, the project includes an additional work package that will combine the management, dissemination, education and training activities.

B 1.3.2. Timing of work packages and their components

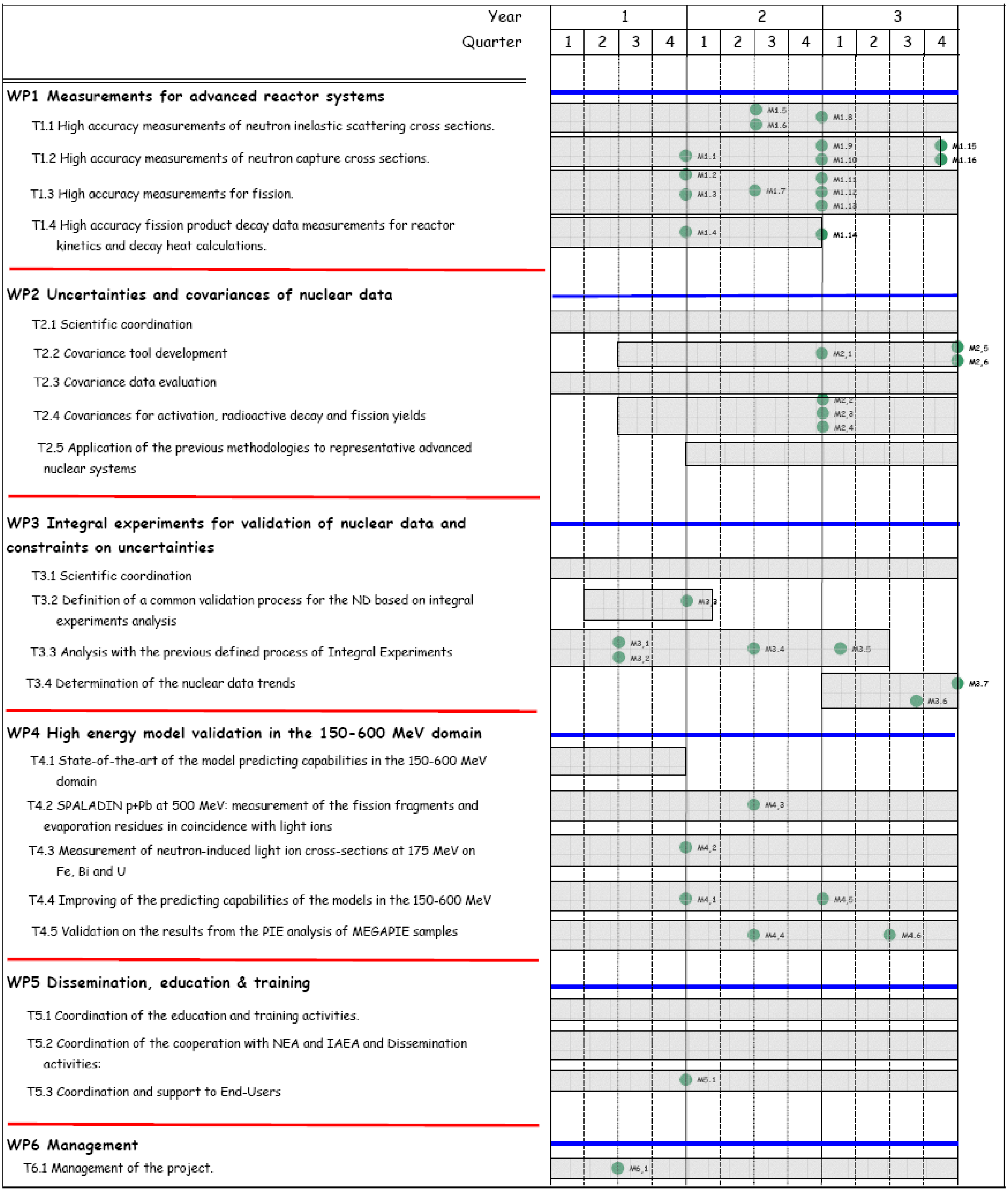

Figure 1: Gantt chart of the project

Timing is relative to the start date of your grant agreement, expressed in months, quarters and years.

B 1.3.3. Work package list /overview

The project will be organized in 4 technical work packages, one work package specifically designed to implement dissemination, education and training and another one for the administrative, finantial and legal management. The work packages topics are:

WP1: Measurements for advanced reactor systems

WP2: Uncertainties and covariances of nuclear data

WP3: Integral experiments for validation of nuclear data and constraints on uncertainties

WP4: High energy model validation in the 150-600 MeV energy domain

WP5: Dissemination, education & training

WP6: Management

The main purpose of WP1 will be to perform a few measurements of relevant reactions/isotopes from the priorities identified in the sensitivity analyses of Gen IV (NEA/WPEC-26) and advanced fuel cycles (NUDATRA), also taking into account the indications from CANDIDE and the NEA and IAEA High Priority Request Lists (HPRL).

The list includes major isotopes from U/Pu fuel cycle, minor actinides relevant for closed fuel cycles and waste minimization by Partitioning and Transmutation, plus a few stable structural and fuel matrix isotopes. The reactions include fission, inelastic, capture and total. The experiments will be performed combining the possibilities and different systematic of the IRMM@Geel and nTOF@CERN, GANIL, CNRS/IPNO and JYU cyclotron facilities.

The coordination with the EC projects EUFRAT and EFNUDAT (and its continuation if any) will be maximized to support the access to these facilities.

The WP2 will include the evaluation activities to significantly improve the quality and availability of covariance data in the evaluated nuclear data libraries, and the development and demonstration of codes fully exploiting these data.

In the first aspect the cooperation of evaluators, theorists and experimentalists will be used to produce high quality and complete covariance matrices plus the necessary methodologies. In the second, the utilization of different covariance matrices should be automated in several codes and their demonstration should be used to illustrate the potential benefit of generalizing the assessment of simulation results with full uncertainties propagation including the ones derived from basic data. These applications should cover the reactor and the fuel cycles, and could use both direct sensitivity/uncertainty methods and Monte Carlo methods.

Integral experiments will be used in WP3, both, to provide the final validation of basic data and to constrain the uncertainties and covariance of these data. Taking into account the available budget and the typical preparation time of these experiments, previously available experimental data from integral experiments will be used in this project. The advanced methodology should be able, however, to extract new constrains for nuclear data, and to validate the methodology for additional analysis of similar integral experiments.

There has been large progress on the high energy reaction models in the last years, but still better precision is needed to reduce uncertainty margins particularly in the range of energies below 600 MeV. This will be the objective of WP4. The activities will start by a precise assessment of the uncertainties remaining from the systematic comparison of models and experiments in this energy range, followed by new specific measurements for this energy range and an analysis of the constrains induced from existing experiments to the parameters of the models. The WP4 will also include further integration of the latest versions of the models into standard simulation codes, including the projection to full scale simulations.

WP5 will coordinate the activities on education and training to make sure that the PhD. students and post-docs involved in the project obtain adequate training in nuclear data but also in other aspects of the nuclear generation of electricity. The training opportunities from this project will be open to participants in related EU activities. At the same time the training together with the dissemination aspects should help to distribute the results and integrate in the interpretation and discussions of the results, a much wider community than the actual project partners. An End-Users group will be organized to coordinate the dissemination and to support these End-Users acquiring and participating in the generation of this know-how. Large conferences open to the full EU nuclear data community will be organized with resources to support the participation of representing persons of associated institutions, allowing also for external scientific contributions.

Finally, WP6 will be dedicated to the general management of the project and its coordination with other ongoing EC projects in the field of advance nuclear systems: reactors, ADS and their fuel cycles.

Work package No	Work package title	Type of activity	Lead participant No	Person months	Start month	End month
1	Measurements for advanced reactor systems	RTD	JRC-IRMM	271.3	1	36
2	Uncertainties and covariances of nuclear data	RTD	NRG	127.7	1	36
3	Integral experiments for validation of nuclear data and constraints on uncertainties	RTD	CEA	134.2	1	36
4	High energy model validation in the 150-600 MeV domain	RTD	CEA	134.4	1	36
5	Dissemination, education & training	OTHER	CIEMAT	7.0	1	36
6	Management	MGT	CIEMAT	4.8	1	36
	TOTAL			679.4		

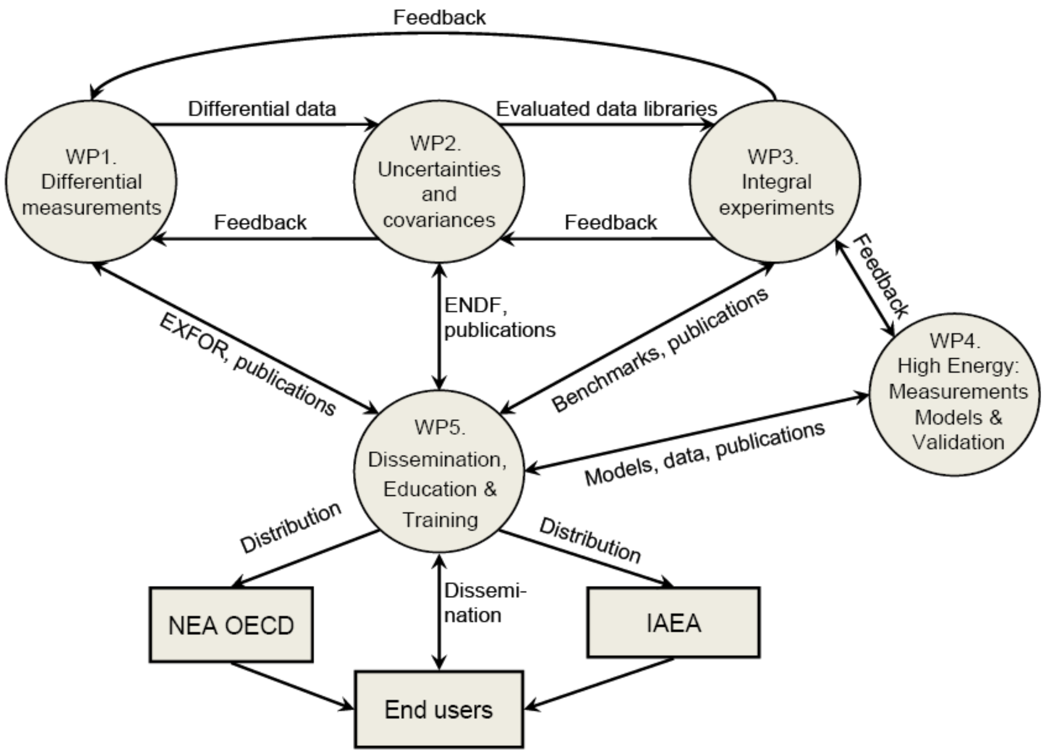

Figure 2: Pert diagram showing the interdependencies of the different work packages of the project

B 1.3.4. Deliverables list

Del. no.	Deliverable name	WP no.	Lead bene-ficiary	Estimated indicative person-months	Nature	Dissemination level	Delivery date
	Work package 1						
D1.1	Final report on the fission cross sections determined for ^{241}Am, ^{243}Am and ^{245}Cm	WP1	INFN	7.1	R	PU	24
D1.2	Final report on the high accuracy ß-decay measurements for ^{88}Br, ^{94}Rb, ^{95}Rb and ^{137}I	WP1	JYU	24.7	R	PU	28
D1.3	Final report on the ^{241}Am total and radiative neutron capture at IRMM and n_TOF	WP1	CEA/DSM	32.6	R	PU	28
D1.4	Final report on the feasibility of the determination of surrogate neutron capture reaction cross sections for curium	WP1	CNRS/ CENBG	26.3	R	PU	30
D1.5	Final report on the fission cross section measurements for ^{240}Pu, ^{242}Pu	WP1	JRC	30.6	R	PU	30
D1.6	Final report for covariances and uncertainty limits of the (n,n'γ)-technique	WP1	IFIN-HH	26.2	R	PU	32
D1.7	Final report on neutron inelastic scattering cross section measurements for ^{238}U	WP1	CNRS/ IPHC	22.9	R	PU	33
D1.8	Final report on the ^{238}U total and radiative neutron capture at IRMM and n_TOF	WP1	JRC	32.6	R	PU	34
D1.9	Final report on the feasibility of the determination of surrogate neutron fission reaction cross sections for ^{238}Pu	WP1	CNRS/ CENBG	28.3	R	PU	34
D1.10	Final report on the feasibility of fission yield measurements with the transfer technique for isotopes of Np, Pu and Cm	WP1	CNRS/ GANIL	12.5	R	PU	36
D1.11	Final report on measurements for non-actinde inelastic scattering cross sections	WP1	JRC	27.5	R	PU	36
	Work package 2						
D2.1	Activation data libraries for Monte Carlo uncertainty propagation in fuel cycle code ACAB	WP2	UPM	7.5	R	PU	12
D2.2	Report on evaluation of ^{239}Pu/^{238}U and ^{241}Am	WP2	UB	24.7	R	PU	30
D2.3	Software package for experimental covariance matrix	WP2	CEA/DAM	31.4	R	PU	30
D2.4	Evaluated ENDF formatted file for	WP2	NRG	16.7	O	PU	36

	$^{239}Pu/^{238}U$ and ^{241}Am.						
D2.5	Report with transmutation calculations for advanced reactors with new covariance data + updated sensitivity tables.	WP2	NNL	25.2	R	PU	36
D2.6	Report on the impact of uncertainties of the fission product nuclear data on the inventory of the irradiated fuel for ACAB	WP2	UPM	22.2	R	PU	36
	Work package 3						
D3.1	Report on definition of the generic strategy for verification/validation benchmark	WP3	CEA/DEN	17.7	R	PU	14
D3.2	Report on analysis of MUSE experiment and C/E + sensitivity vectors	WP3	CIEMAT	11.6	R	PU	20
D3.3	Report on analysis of the IRPhE experiments and C/E + sensitivity vectors	WP3	JSI	23.0	R	PU	20
D3.4	Report on criticality benchmark experiment and C/E + sensitivity vectors	WP3	NRG	19.4	R	PU	24
D3.5	Report on analysis of the PROFIL experiment and C/E + sensitivity vectors	WP3	CEA/DEN	11.8	R	PU	28
D3.6	Report on analysis of VENUS-F core (GUINEVERE) experiment and C/E + sensitivity vectors	WP3	SCK-CEN	10.6	R	PU	30
D3.7	Report on the analysis of constraints on nuclear data and resulting trends	WP3	CNRS	18.0	R	PU	32
D3.8	Report on the analysis of the impact of the new evaluations with Covariance coming from WP2	WP3	CEA/DEN	22.1	R	PU	36
	Work package 4						
D4.1	Report on the predicting capabilities of the standard simulation tools in the 150-600 MeV energy range	WP4	CEA/DSM	16.2	R	PU	12
D4.2	New versions of the INCL4 and ABLA models improved in the 150-600 MeV domain (report and codes)	WP4	ULG	33.6	R	PU	30
D4.3	Final high-energy evaluated data files and benchmarks comparison	WP4	NRG, CEA/DAM	13.6	R	PU	30
D4.4	Experimental results from the SPALADIN experiment on p+Pb at 500 MeV (report and EXFOR library)	WP4	USC	27.9	R	PU	36
D4.5	Light-ion production cross-sections from n+Fe, Bi and U at 175 MeV (report and EXFOR library)	WP4	UU	13.2	R	PU	36
D4.6	Report on the validation of the simulation tools developed in Task 4.4 and assessment of the expected reduction of uncertainty on key parameters of the ADS	WP4	CEA/ DSM	16.9	R	PU	36

D4.7	Experimental results from the MEGAPIE sample analysis	WP4	PSI	13.0	R	PU	36
	Work package 5						
D5.1	Disemination and Use plan	WP5	NRG	1.4	R	PU	12
D5.2	One Open Training course	WP5	UU	1.8	R	PU	30
D5.3	Report on dissemination activities	WP5	NRG	0.8	R	PU	36
D5.4	Final Report on the activities of End-Users group	WP5	CEA/ DSM	3.0	R	PU	36
	Work package 6						
D6.1	Final version of the ANDES web	WP6	CIEMAT	0.7	O	PU	36
D6.2	Final report of the project	WP6	CIEMAT	4.1	R	PU	36

B 1.3.5. Work package descriptions

Work package 1 Start date or starting event: month 1

Work package title	Measurements for advanced reactor systems (MARS)								
Activity Type[1]	RTD								
Participant number	1	2	3	5	6	7	8	10	19
Participant short name	CIEMAT	CEA/ DSM+DAM	CNRS	IFIN-HH	INFN	ITN	JRC	JYU	USC
Person-months per participant	26.8	26	82	33.3	28.1	10	46.7	16.7	1.7

Coordinator: JRC. Duration: 36 months

Objectives: WP1 will perform high quality nuclear data measurements on key isotopes and reactions selected from a list of identified priorities. This list of priorities resulted from recent nuclear data sensitivity studies for advanced reactor systems [4][5]. This work package has the ambition to achieve the lowest possible uncertainty for each type of measurement proposed, and to come as close as is reasonably achievable to the target uncertainties established in references [4][5]. WP1 follows closely the recommendations of the Coordination Action for Nuclear Data for Industrial Development in Europe, CANDIDE [6], that addressed how to meet these prioritized targets and additional important nuclear data issues. In this work package there are four major specific objectives subdivided in specific components which are reflected in the task, deliverables and milestones lists:

1. High accuracy measurements of neutron inelastic scattering cross sections.
- To improve with new measurements the cross sections for neutron inelastic scattering off ^{238}U.
- To improve with new measurements the cross sections for neutron inelastic scattering off structural materials and inert fuel components.
- To provide covariances and the limits of accuracy for measurements with the (n,n'γ)-technique.

2. High accuracy measurements of neutron total and capture cross sections.
- To improve with new measurements the n+^{238}U radiative neutron capture cross sections.
- To improve with new measurements the n+^{241}Am radiative neutron capture cross sections.
- To assess the use of transfer reactions for the determination of neutron-induced capture cross sections for actinide targets.

3. High accuracy measurements of fission cross sections
- To improve with new measurements the neutron-induced fission cross section of Pu isotopes.
- To improve with new experimental results the fission cross sections of the minor actinides.
- To improve the experimental knowledge of the fast neutron induced fission yields for isotopes of Np, Pu and Cm by surrogate neutrons and inverse kinematics.

4. State of the art decay data measurements for reactor kinetics and decay heat
- To improve the experimental information for the beta decay probability and strength functions of relevant fission fragments.
- To improve the experimental information for the delayed neutron emission probabilities of relevant fission fragments.

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[1] Please indicate one activity per work package:
RTD = Research and technological development (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities – only possible for Collaborative projects); DEM = Demonstration (only possible for Collaborative projects); MGT = Management of the consortium; COORD = Coordination activities (for Coordination Actions); SUPP = Support activities (for Support Actions); OTHER = Other specific activities (including training), if applicable

The goals of the tasks are ambitious and clearly aim at improving nuclear data to allow improved simulation and modeling of advanced reactor systems. The success of the work package tasks and subtasks will be evaluated at end of project. One of the following distinctions will be assigned. 1) *Excellent* for studies that have reported uncertainties that meet the target derived from sensitivity studies for advanced reactors (OECD report WPEC subgroup 26), 2) *Very good* for studies that report uncertainties of 5% or better or demonstrated methods of measurement that allow what is currently not feasible, 3) *Good* for significant advancement of uncertainties and methods over the state-of-the-art, 4) *Satisfactory* results that show a better understanding of measurements, qualifying the state-of-the-art and 5) *Unsuccessul*.

Task progress will be indicated by percentage task completion in the intermediate progress review reports and compliance may be inferred accordingly. Non-compliance will be stated at the earliest dates at which they appear, in order to allow timely corrective action.

- Although, sensitivity studies for advanced reactors did not point out needs for thermal cross sections, it is important to have accurate data at this energy for various reasons. The IAEA organises a Technical Meeting on "Specific Applications of Research Reactors: Provision of Nuclear Data" 12-16 October 2009 IAEA, Vienna, Austria isee http://www-naweb.iaea.org/napc/physics/meetings/TM38228.html Conclusions from this technical meeting will be taken into account to investigate possible alternatives for measurement activities. A close contact will be maintained between the work package and the developments resulting from this meeting.

Description of work: *(possibly broken down into tasks), and role of participants*

For all tasks there are cross links with WP2 for interpretation, evaluation and uncertainty-covariance methodology for the experimental results. Participants to WP3 are among the eventual End-Users of the results of this WP.

Task 1.1. High accuracy measurements of neutron inelastic scattering cross sections. (*Task leader*: CNRS/IPHC, *Partners*: CNRS/IPHC, JRC, IFIN-HH)

Subtask 1.1.a. Neutron inelastic scattering off ^{238}U. (*Subtask leader:* CNRS/IPHC, *Partners:* CNRS/IPHC, JRC, IFIN-HH).
Determination of neutron-induced gamma-production cross sections resulting from inelastic scattering off uranium. These data will be used to improve the modeling of neutron-induced reactions on ^{238}U and will therefore contribute to improving the very important inelastic scattering cross section for this nucleus. The IPHC setup at GELINA will be used with a new uranium sample. Special attention will be paid to systematic effects, final uncertainties and correlations.

Subtask 1.1.b. Neutron inelastic scattering off structural materials and inert fuel components. (*Subtask leader:* JRC/IRMM, *Partners:* CNRS/IPHC, JRC/IRMM, IFIN-HH).
Neutron-induced gamma-production cross sections for inelastic scattering off ^{23}Na, Zr, Mo will be measured and total and level inelastic cross sections up to about 4 MeV will be derived. These data will be used to improve modeling of neutron-induced reactions thus contributing to improving the uncertainties associated with these inelastic scattering cross sections. The GAINS setup at the GELINA facility will be used with samples prepared at IRMM.

Subtask 1.1.c. Covariances for and uncertainty limits of measurements with the (n,n'γ)-technique**.** (*Subtask leader:* IFIN-HH, *Partners:* CNRS, JRC, IFIN-HH)
Given the difficulty of obtaining high accuracy results for neutron inelastic scattering and the important requirements from energy applications, it is of utmost interest to understand the limits of uncertainties that may be achieved with this successful technique and how to generate reliable covariance matrices. This subtask will implement a methodology for covariance generation and apply it to cases of interest (Fe, Si, and Mg, and if time allows ^{238}U and ^{23}Na). The limits of uncertainty for the technique will be determined.

Task 1.2. High accuracy measurements of neutron capture cross sections. (*Task leader:* CEA, *Partners:* CEA, CIEMAT, CNRS, JRC, INFN, ITN)

Capture data for ^{238}U and ^{241}Am will be measured and the feasibility of determining curium (n,γ) cross sections using transfer reactions will be assessed. For ^{238}U and ^{241}Am, the simultaneous measurements of critical cross sections by closely connected teams in different facilities will provide unique complementarities and reduction of systematic uncertainties, an approach essential to obtain significant results for these important reactions.

Subtask 1.2.a. ^{238}U total and radiative neutron capture measurements at JRC (*Subtask leader:* JRC, *Partners:* CEA, CIEMAT, JRC)
Total and capture cross section measurements will be performed at the GELINA facility applying the time-of-flight technique and transmission factors and capture yields will be determined. Resonance shape analysis to deduce resonance parameters and statistical nuclear reaction analysis to deduce average resonance parameters and average cross sections will be employed.

Subtask 1.2.b. ^{241}Am total and radiative neutron capture at JRC (*Subtask leader:* CEA, *Partners:* CEA, JRC, CIEMAT)
Capture cross sections will be determined from measurements performed at the GELINA facility with the the time-of-flight technique and capture yields will be derived. Resonance shape analysis to deduce resonance parameters and statistical nuclear reaction analysis to deduce average resonance parameters and average cross sections will be employed.

Subtask 1.2.c. ^{238}U radiative neutron capture measurements at CERN n_TOF (*Subtask leader:* CEA, *Partners:* CEA, CIEMAT, INFN, ITN, JRC)
Capture cross section measurements will be performed at n_TOF with two different arrangements: C6D6 total energy detectors and the n_TOF total absorption calorimeter. Capture yields will be deduced and resonance shape analysis will be performed to deduce resonance parameters in the resolved resonance region, while statistical nuclear reaction models will be applied to deduce average resonance parameters and average cross sections in the unresolved resonance region.

Subtask 1.2.d. ^{241}Am radiative neutron cross section at the CERN n_TOF facility (*Subtask leader:* CIEMAT, *Partners:* CEA, CIEMAT, INFN, ITN, JRC)
Measurements will be made at n_TOF with the total absorption calorimeter and processed to capture yields. Resonance shape and unresolved resonance range analysis will be performed in a manner comparable to subtask 1.2.b and the results will be compared.

Subtask 1.2.e. Feasibility of measuring surrogate neutron capture cross sections for Cm isotopes (*Subtask leader:* CNRS/CENBG, *Partners:* CNRS/CENBG, CEA/DAM, CEA/DEN, JRC)
The surrogate reaction method (which combines experiment with reaction theory) has been used intensively for the determination of (n,f) cross section for nuclei which are not available for direct neutron studies. Nevertheless, the method needs further investigations before applying it to (n,?) reactions. This will be the goal of this task. The validity of the method will be studied with selected non-actinide and actinide targets whose (n,?) cross sections are well established. As a pilot case either the $^{241}Am(n,\gamma)$ or the $^{243}Am(n,\gamma)$ reaction will be taken, while the curium example concerns the $^{244}Cm(n,\gamma)$ reaction. The corresponding transfer reactions are $^{240}Pu(^{3}He,p\gamma)^{242}Am$ (for ^{241}Am+n) or $^{242}Pu(^{3}He,p\gamma)^{244}Am$ (for ^{243}Am+n) and $^{243}Am(^{3}He,p\gamma)^{245}Cm$ (for ^{244}Cm+n).

Task 1.3. High accuracy measurements for fission (*Task leader:* CNRS/CENBG, *Partners:* CNRS, INFN, ITN, JRC)

This task will make a significant contribution to the experimental knowledge for neutron-induced fission cross sections of ^{238}Pu, ^{240}Pu and ^{242}Pu for which accurate results are required for advanced reactors and of ^{241}Am, ^{243}Am and ^{245}Cm. In addition results of relevance for decay heat and delayed neutrons estimates will be obtained in the form of fission yields for n+Pu, Np and Cm. For ^{240}Pu (^{242}Pu) fission cross-sections with an uncertainty of 2-3% (4%) are needed in the neutron energy range from 0.5 to 6 MeV, to be compared to the current uncertainty of 6 % (20%). It must be noted that the challenge of reducing uncertainties for the $^{240,242}Pu$ neutron-induced fission cross sections to the level required by sensitivity studies for advanced reactors is very large. Therefore, several high accuracy measurements complementary to earlier work and complementary to each other are proposed. Comparison of the results and interaction between the teams involved is essential to make a significant reduction of the final experimental uncertainty.

Subtask 1.3.a. Determination of the ^{238}Pu(n,f) cross section by measurements with the transfer reaction ^{237}Np(^{3}He,pf) (S*ubtask leader:* CNRS/CENBG, *Partners:* CNRS, CEA)
Direct measurement of the ^{238}Pu(n,f) reaction cross section is a major challenge due to the short half-life of the target isotope. However, the well-tested indirect (surrogate) method using transfer reactions may be used, and has been applied with success for fission cross sections of short-lived Am and Cm isotopes. Here, we propose to measure the fission probability of ^{239}Pu using the transfer reaction ^{237}Np(^{3}He,p)^{239}Pu at the CNRS/IPNO tandem accelerator. The ^{238}Pu(n,f) reaction cross section will be deduced from the product of the measured fission probability and the calculated compound nucleus formation cross section.

Subtask 1.3.b. Measurement of the ^{240,242}Pu(n,f) cross sections relative to the ^{238}U(n,f) cross section at the VdG laboratory of IRMM (*Subtask leader:* JRC, *Partners:* CNRS/CENBG, JRC)
Most of the fission cross sections for ^{240,242}Pu are measured relative to the ^{235}U(n,f) cross section. To obtain accurate independent results, measurements relative to the ^{238}U(n,f) standard cross section will be made. The present measurements concern the energy range above 0.5 MeV. A Frisch-gridded ionization chamber will be used with back-to-back ^{240}Pu or ^{242}Pu and ^{238}U samples. This method is well understood and was the basis of recent high quality results obtained at the JRC-IRMM Van de Graaff laboratory for ^{233}Pa and ^{231}Pa.

Subtask 1.3.c. Measurement of the ^{240,242}Pu(n,f) cross sections relative to the ^{1}H(n,p) cross section (*Subtask leader:* CNRS/CENBG, *Partners:* CNRS, JRC)
Most of the fission cross sections are measured relative to the ^{235}U(n,f) cross section, leading to un uncertainty around 3% at 1 MeV. The very well known H(n,p) scattering cross section (0.5% between 1 keV and 20 MeV) allows quasi-absolute cross section measurements. We propose to use the H(n,p) scattering cross section as a standard to obtain more precise results for the ^{240}Pu(n,f) and ^{242}Pu(n,f) cross in the range from 0.5 to 8 MeV. We have already applied this technique to an accurate measurement of the ^{243}Am(n,f) cross section. The setup will consist of a Pu target and polyethylene thin foil placed back to back. Fission fragments will be detected by solar cells. Recoil protons from the polyethylene foil will be detected by a silicon telescope.

Subtask 1.3.d. Measurement of the ^{240,242}Pu(n,f) cross sections relative to ^{235}U(n,f) (*Subtask leader:* INFN, *Partners:* INFN, ITN, JRC)
High accuracy data for these isotopes can be obtained by using state-of-the-art techniques and setups. Measurements of ^{240}Pu(n,f) and ^{242}Pu(n,f) will be performed at n_TOF, provided a Class B Laboratory is established by CERN, or otherwise at GELINA, taking advantage of the convenient features of these facilities and exploiting innovative, fast detection systems recently developed (Fast Ionization Chamber or the new fission detector based on the Microbulk concept, recently built and tested at n_TOF and GELINA). The aim is to provide high resolution cross sections from sub-threshold cross to 2 MeV.

Subtask 1.3.e. Improved analysis of the ^{241,243}Am(n,f) and ^{245}Cm(n,f) cross sections measured at nTOF (*Subtask leader:* INFN, *Partners:* INFN)
The fission cross sections of ^{241}Am, ^{243}Am and ^{245}Cm have been measured at n_TOF. However, the systematic uncertainty in the results is around 10%; too high for the requirements of advanced nuclear systems. A reduction of the uncertainty of the n_TOF data could be achieved by a more refined analysis of those data, in particular by a more precise assessment of the background contribution and of the detection efficiency. Combining the n_TOF results with new data from other facilities, the final uncertainty in the absolute normalization of the cross-section may be minimized.

Subtask 1.3.f. Measurements of fission fragment isotopic distributions and fission probabilities for Np, Pu, Cm (*Subtask leader:* CNRS/GANIL, *Partners:* CNRS/GANIL+CENBG+IPNO, CEA/DAM, USC)
The surrogate technique and inverse kinematics will be used to determine isotopic fission fragment yields in heavy actinides at the GANIL VAMOS spectrometer. Inverse kinematics allows for an isotopic identification of fission fragments, and a large transfer of nucleons allows for producing

heavy actinides in the different transfer channels. The method is at present limited by the isotopic identification of the actinides produced. Detection equipment will be improved, and should bring the requested resolution for the isotopic identification of the actinides. The method will be validated with existing data for the ^{241}Pu(n,f) reaction. This work is a feasibility study of the method.

Task 1.4 High accuracy fission product decay data measurements for reactor kinetics and decay heat calculations. (*Task leader*: JYU, *Partners*: CIEMAT, JYU)

Subtask 1.4.a. Total absorption gamma–ray spectroscopy of ^{88}Br, ^{94}Rb, ^{95}Rb and ^{137}I (*Subtask leader:* JYU, *Partner:* CIEMAT, JYU)
Determination of the ß-decay probability and ß-strength function as a function of the excitation energy in the daughter nucleus and of the ?–ray intensity. The nuclides ^{88}Br and ^{137}I were recommended to be measured in a recent report of the OECD Nuclear Energy Agency [7]. The data will be taken at the JYU cyclotron and calibrated with reference cases.

Subtask 1.4.b. ß-delayed neutron emission probabilities of ^{88}Br, ^{94}Rb, ^{95}Rb and ^{137}I (*Subtask leader:* CIEMAT, *Partners:* CIEMAT, JYU)
Determination of the ß-delayed neutron emission probabilities of ^{88}Br,^{94}Rb, ^{95}Rb and ^{137}I at the JYU cyclotron. The data will be used to determine the complete neutron, gamma and beta particle emission probabilities and average energies, and to improve the databases for reactor decay heat calculations. The data will be taken at the JYU cyclotron with the JYFLTRAP penning trap at the IGISOL facility for isotopic purification of the beam and calibrated with reference cases.

Deliverables: *(brief description and month of delivery)*

D1.1 Final report on the fission cross sections determined for ^{241}Am, ^{243}Am and ^{245}Cm (M24)(INFN)
D1.2 Final report on the high accuracy ß-decay measurements for ^{88}Br, ^{94}Rb, ^{95}Rb and ^{137}I (M28) (JYU).
D1.3 Final report on the ^{241}Am total and radiative neutron capture at IRMM and n_TOF (M28) (CEA/DSM)
D1.4 Final report on the feasibility of the determination of surrogate neutron capture reaction cross sections for curium (M30)(CNRS/CENBG)
D1.5 Final report on the fission cross section measurements for ^{240}Pu, ^{242}Pu (M30)(JRC)
D1.6 Final report for covariances for and uncertainty limits of the (n,n'γ)-technique (M32) (IFIN-HH)
D1.7 Final report on neutron inelastic scattering cross section measurements for ^{238}U (M33) (CNRS/IPHC)
D1.8 Final report on the ^{238}U total and radiative neutron capture at IRMM and n_TOF (M34) (JRC)
D1.9 Final report on the feasibility of the determination of surrogate neutron fission reaction cross sections for ^{238}Pu (M34) (CNRS/CENBG)
D1.10 Final report on the feasibility of fission yield measurements with the transfer technique for isotopes of Np, Pu and Cm (M36)(CNRS/GANIL)
D1.11 Final report on measurements for non-actinde inelastic scattering cross sections (M36) (JRC)

Milestones: *(brief description and month of milestones)*

M1.1 Processing of ^{241}Am total and radiative neutron capture measurements at IRMM (M12)
M1.2 Measurements for the ^{238}Pu fission cross section by the transfer method (M12)
M1.3 Analysis of n_TOF ^{241}Am, ^{243}Am and ^{245}Cm fission cross section data (M12)
M1.4 Measurements of the ß-decay of the ^{88}Br, ^{94}Rb, ^{95}Rb and ^{137}I isotopes with a total absorption spectrometer (M12)
M1.5 Measurements of inelastic scattering off ^{238}U (M18)

M1.6 Methodology implementation for covariance generation for (n,nγ) measurements (M18)
M1.7 Measurements of fission yields with VAMOS at GANIL (M18)
M1.8 Measurements of neutron inelastic scattering off non-actinide components (M24)
M1.9 Measurements of the ^{241}Am radiative neutron cross section at the n_TOF facility (M24)
M1.10 Measurements of the Cm capture cross section by the transfer method (M24)
M1.11 New measurements of fission cross sections for $^{240,242}Pu$ at CENBG (M24)
M1.12 New measurements of fission cross sections for $^{240,242}Pu$ at the JRC-IRMM VdG laboratory (M24)
M1.13 New measurements of fission cross sections for $^{240,242}Pu$ at n_TOF (M24)
M1.14 Measurements of the ß-decay of the ^{88}Br, ^{94}Rb, ^{95}Rb and ^{137}I isotopes with neutron detectors (M24)
M1.15 Measurements of the ^{238}U total and radiative neutron capture cross sections at IRMM (M34)
M1.16 Measurements of the ^{238}U radiative neutron capture cross sections at nTOF (M34)

Work package 2 **Start date or starting event: month 1**

Work package title	Uncertainties and covariances of nuclear data						
Activity Type[2]	RTD						
Participant number	1	2	11	12	15	16	18
Participant short name	CIEMAT	CEA/ DAM+DEN	NNL	NRG	TUW	UB	UPM
Person-months per participant	8.9	24.9	10.2	19.9	20.7	14.5	28.6

Coordinator: NRG. Duration: 36 months

Objectives:

An adequate determination of safety and economical margins of nuclear systems relies directly on the uncertainties of nuclear data. Therefore, in this WP the objective is to enhance the European capability to produce covariance data for isotopes which are important for advanced reactors, as identified from recent sensitivity studies on GEN-IV reactors and ADS. The emphasis will be on the thermal, resonance and fast neutron energy ranges.

Three different aspects of nuclear data evaluation need to come together to accomplish this:

1. Uncertainty/covariance evaluation of experimental data
2. Uncertainty/covariance evaluation of data from nuclear reaction models
3. A proper theoretical treatment and evaluation of nuclear reactions on actinides (especially fission models) and its relation with 1. and 2.

In addition to nuclear reaction data, radioactive decay and fission yield data need to be accompanied with associated covariance data. Finally, the new covariance data for nuclear reactions, radioactive decay and fission yields will be used in adapted processing and reactor/fuel cycle codes to calculate the impact on advanced reactor parameters.

Description of work:

Task 2.1: Scientific coordination (*Task leader*: NRG**)**

This includes reporting progress to the coordinator and ensuring maximal synergy between the tasks and partners. Also demonstration of the WP's accomplishments in international forums is foreseen.

Task 2.2: Covariance tool development (*Task leader*: TUW; *Participants*: TUW, CEA-DAM,CEA/DEN)

Three specific covariance-oriented computer tools will be developed:

A computer tool will be built by CEA-DAM to assist the evaluator in the construction of an experimental covariance matrix based on the information available in the original papers describing

[2] Please indicate one activity per work package:

RTD = Research and technological development (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities – only possible for Collaborative projects);

DEM = Demonstration (only possible for Collaborative projects); MGT = Management of the consortium;

COORD = Coordination activities (for Coordination Actions); SUPP = Support activities (for Support Actions); OTHER = Other specific activities (including training), if applicable

the measurements. Statistical and systematic errors would be treated separately, with all types of systematic correlations (stemming from sample, experimental geometry, beam normalization reaction for example) being treated properly.

The general evaluation tool GENEUS will be extended by TUW to include fission observables. The code is based on the concepts of Bayesian statistics, which provides a complete evaluation including mean values of observables and cross section covariance matrices. As before, the package is connected to the TALYS code, but will now also make use of its new fission capabilities.

The CONRAD code will be extended by CEA/DEN to include a more general experimental covariance treatment.

Task 2.3: Covariance data evaluation (*Task leader*: NRG; *Participants*: NRG, CEA-DAM, UB)

Methods will be developed that provide the best possible covariance data in nuclear data libraries. Activities required to accomplish this include:

- Assessing uncertainty ranges for nuclear model parameters, especially for actinides.
- Investigation and implementation of Unified Monte Carlo: i.e. a method for the precise determination of both theoretical and experimental based covariance data.
- ENDF-6 formatting: the results should be ready to store in ENDF-6 data libraries and should be successfully processed for application (in WP3, among others).
  The size of the project restricts us to apply these developments on one major actinide (^{239}Pu or ^{238}U) and one minor actinide (^{241}Am). The quality of the libraries will be assessed by comparing them with the existing data libraries in the world. The libraries will contain the uncertainties delivered by al ANDES workpackages.

  The TALYS code system, which has provided already many evaluations for the European JEFF library, is the central tool to provide the covariance data, together with the new codes mentioned under 2.2. However, general code-independent covariance methods, for e.g. the optical model, level densities and fission, will also be developed, and the EMPIRE-II and GANDR systems will also be used as complementary tools both for theoretical modeling and nuclear data and covariance evaluations.

Task 2.4: Covariances for activation, radioactive decay and fission yields (*Task leader*: UPM; *Participants*: UPM, NRG, NNL, CIEMAT)

For a number of important nuclides, complete activation data libraries with covariance data will be produced, so that uncertainty propagation in fuel cycle codes, in this case ACAB, can be developed and tested.

Eventually, fuel inventory codes should be able to handle the complete set of uncertainty data, i.e. those of nuclear reactions (cross sections, etc.), radioactive decay and fission yield data. For this, capabilities will be developed both to produce covariance data and to propagate the uncertainties through the inventory calculations. Demonstrations on a realistic burn-up case will be provided.

Task 2.5: Application of the previous methodologies to representative advanced nuclear systems (reactors and fuel cycles) (*Task leader*: CIEMAT, *Participants*: CEA, NNL, NRG, UPM)

The produced covariance files will be used to test uncertainty propagation in reactor and fuel cycle codes, to determine the uncertainty of a the most important reactor and fuel cycle parameters in selected systems and fuel cycles. The EUROTRANS and CP-EFSR reactor models and fuel cycles from the RED-IMPACT FP6 project will be used as reference cases.

Deliverables: *(brief description and month of delivery)*

D2.1. Activation data libraries for Monte Carlo uncertainty propagation in fuel cycle code ACAB (M12)(UPM)
D2.2. Report on evaluation of $^{239}Pu/^{238}U$ and ^{241}Am. (M30) (UB)
D2.3. Software package for experimental covariance matrix (M30) (CEA-DAM)
D2.4. Evaluated ENDF formatted file for $^{239}Pu/^{238}U$ and ^{241}Am. (M36) (NRG)
D2.5. Report with transmutation calculations for advanced reactors with new covariance data + updated sensitivity tables. (M36) (NNL)
D2.6. Report on the impact of uncertainties of the fission product nuclear data on the inventory of the irradiated fuel for ACAB (UPM) (M36)

Milestones: *(brief description and month of delivery)*

M2.1. Report on extension of GENEUS code package including TALYS++: Especially the details on the evaluation of covariance matrices for the prior for fission observables will be given. (M24) (TUW)
M2.2. Report on the usability of Monte Carlo uncertainty propagation in fuel cycle codes, and comparison with conventional approach (M24) (UPM/UNED, NRG, CIEMAT).
M2.3. An upgraded ACAB code, which now will deal with cross-channel and cross-nuclide correlations. (M24) (UPM/UNED)
M2.4. New computational method for the use of covariance information of reaction, decay and fission yield data in an inventory calculation (M24) (NNL).
M2.5. A new release of CONRAD (M36) (CEA/DEN).
M2.6. A new release of TALYS, publicly available on the TALYS website (M36) (NRG, CEA-DAM)

Work package 3 **Start date or starting event: month 1**

Work package title	Integral experiments for validation of nuclear data and constraints on uncertainties					
Activity Type[3]	RTD					
Participant number	1	2	3	9	12	14
Participant short name	CIEMAT	CEA/DEN	CNRS	JSI	NRG	SCK-CEN
Person-months per participant	17.8	35.3	23	40.1	11.1	6.9

Coordinator: CEA/DEN. Duration: 36 months

Objectives:

The goal of this work package is to agree on a common methodology to use the integral experiments to improve and validate nuclear data and to constrain their uncertainties. To reach this goal, it is necessary to define and share the methodology between the participants, and apply it to different kinds of integral experiments of the public domain, to be able to estimate the impact of the new evaluations with covariances (provided in WP2) to the knowledge of the neutronic behavior as measured in the analyzed integral experiments.

Description of work: *(possibly broken down into tasks), and role of participants*

Task 3.1: Scientific coordination (CEA/DEN)

Task 3.2: Definition of a common validation process for the ND based on integral experiments analysis (to be used in the task 3.3) (*Participants*: ALL)

Task 3.3: Analysis with the previous defined process of Integral Experiments (*Participants*: ALL)

Two important aspects have to be considered in choosing the type of experiments that we want to analyze in this task: the first one is to consider open experiments (available from NEA/OECD, IAEA data bases or open literature) to let every participant of this project the opportunity to perform the analysis with their own calculation tool; the second aspect, that drives the choice of the following set of experiments, to cover part of the new fast reactors applications and several of the different characteristics of the reactor (critical mass, spectral indices, power distribution and also depletion calculations).

The proposed experiments are:

- The Muse Reference core [8] characterization gives a number of spectral indices and reaction rate traverses and the critical mass of a sodium cooled fast reactor with UO_2-PuO_2 fuel and steel reflector. This experiment has been performed with partial support of the FP5 of EURATOM.

[3] Please indicate one activity per work package:
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- The ZPPR10A experiment proposed in IRPhE of the NEA Data Bank. This experiment is complementary of the first one because sodium void effects have been measured and are available.
- SNEAK-7A and -7B fast critical experiments included in the recent edition of the IRPhE Handbook of OECD/NEA Data Bank. The benchmarks are fueled with PuO_2-UO_2 and reflected by metallic depleted uranium. K_{eff}, buckling, reaction-rate ratios, material worth, fission-rate and capture-rate distributions were measured.
- The PROFIL experiments [9], performed in the PHENIX demonstration fast reactor irradiated 130 small separate samples containing almost pure isotopes. These highly accurate experiments are a very specific and powerful source of information on the nuclear data of major and minor actinides and several fission products. This is a CEA experiment that we intend to benchmark and will be provided in the frame of the present project.
- The last integral experiment proposed is the critical fast VENUS-F core of the GUINEVERE program of EUROTRANS. This experiment will provide information on a lead cooled uranium core and cover another type of metal cooled fast reactors.
- To complete this set of experiments, part of the large criticality and shielding benchmark suite, based on the Nuclear Data Sheets [10] will be proposed in this frame. For the first time, consistent uncertainties will be added to the calculated benchmark results.

This task is subdivided into five sub tasks:

SubTask 3.3.1: MUSE Ref Core characterization (CIEMAT, CEA/DEN)

SubTask 3.3.2: ZPPR10A and SNEAK7 experiments available in IRPhE Handbook from the OECD/NEA Data Bank. (JSI, CEA/DEN, CNRS, NRG)

SubTask 3.3.3: PROFIL experiments made in PHENIX on separate isotopes irradiation. (CEA/DEN, CIEMAT, CNRS, SCK-CEN)

SubTask 3.3.4: Integral experiments in critical fast VENUS-F core at SCK-CEN (GUINEVERE) (SCK-CEN, CEA/DEN, CIEMAT)

SubTask 3.3.5: Part of the large criticality and shielding benchmark suite, based on the Nuclear Data Sheets [10] (NRG, CNRS, JSI)

The deliverables are analysis reports based on the methodology processes defined in the Task 3.2 and the computed/experiment values, C/E, with the corresponding sensitivity vectors to be able to make the last task that cover the feedbacks on Nuclear Data, ND.

Task 3.4: Determination of the nuclear data trends: including the analysis of the impact of the new evaluations on the uncertainties on the neutronic behaviors on the integral experiments used in Task 3 (*Participants*: ALL)

SubTask 3.4.1: Provide trends on ND using the C/E and the sensitivity vectors of Task 3.3, covariance matrices on ND (first use the existing one: BOLNA) and provide a recommendation on Nuclear Data validity

SubTask 3.4.2: Analyze the impact of the new evaluations with covariances coming from WP2 and estimate the impact on the C/E and uncertainties of the experiments used in Task 3.3.

Deliverables: *(brief description and month of delivery)*

D3.1: Report on definition of the generic strategy for verification/validation benchmark (M14) (CEA)

D3.2: Report on analysis of MUSE experiment and C/E + sensitivity vectors (M20) (CIEMAT)

D3.3: Report on analysis of the IRPhE experiments and C/E + sensitivity vectors (M20) (JSI)

D3.4: Report on criticality benchmark experiment and C/E + sensitivity vectors (M24) (NRG)

D3.5: Report on analysis of the PROFIL experiment and C/E + sensitivity vectors (M28) (CEA)

D3.6: Report on analysis of VENUS-F core (GUINEVERE) experiment and C/E + sensitivity vectors (M30) (SCK-CEN)

D3.7: Report on the analysis of constraints on nuclear data and resulting trends (with respect to the use the C/E and Sensitivity data coming from the integral experiments) (M32) (CNRS)

D3.8: Report on the analysis of the impact of the new evaluations with Covariance coming from WP2: including the estimation of the impact on the C/E and uncertainties of the integral experiments (M36) (CEA)

Milestones: *(brief description and month of delivery)*

M3.1: Description of the part of the PROFIL experiment made in PHENIX reactor (M6)

M3.2: Description of the part of the VENUS-F core (GUINEVERE) experiment (M6)

M3.3: Code developments to implement the methodology (M12)

M3.4: Interim comparison on the analysis of different systems (M18)

M3.5: Final comparison on the analysis of different systems (M26)

M3.6: Feedback on nuclear data (M32)

M3.7: Impact of the new Covariance coming from WP2 to the analysis of the different experiments (M36)

Work package 4 **Start date or starting event: month 1**

Work package title	High energy model validation in the 150-600 MeV energy domain							
Activity Type[4]	RTD							
Participant number	2	3	4	12	13	17	19	20
Participant short name	CEA DSM-DAM	CNRS	GSI	NRG	PSI	ULG	USC	UU
Person-months per participant	35.3	2	18.8	3	15.7	18.8	29.5	11.3

Coordinator: CEA/DSM. Duration: 36 months

Objectives: The goal of this work package is to provide reliable simulation tools for the design of a future ADS demonstration facility as the MYRRHA/XT-ADS project, which consists of a proton accelerator delivering a 600 MeV - 2.5 mA or 350 MeV - 5 mA proton beam to a liquid Pb-Bi spallation target. The optimization of the spallation target for such a facility, the assessment of the radioprotection and material damage problems related to high-energy reactions, the reduction of the safety margins require simulation tools validated in the energy domain of the demonstration facility and a quantitative estimation of their predicting capabilities.

While there has been of lot of work in the past years devoted to the collection of high-quality data and improvement of high-energy models around 1 GeV and below 150 MeV (among which the work performed within HINDAS and NUDATRA), much less has been done between 150 and 600 MeV, the domain corresponding to the energy of MYRRHA/XT-ADS or other possible demonstration facilities. Therefore, this work package will focus on the improvement of the models in this energy range with validation on the appropriate experimental data. The resulting reduction of uncertainty on key parameters of the ADS demonstrator will be quantified.

Description of work: *(possibly broken down into tasks), and role of participants*

Task 4.1 State-of-the-art of the model predicting capabilities in the 150-600 MeV domain (*Task Leader*: CEA/DSM, *Participants*: ULG, USC)

The first task will be to establish the state-of-the-art regarding the prediction capabilities of the nuclear models used in standard transport codes in the 150-600 MeV domain. This will make use of the conclusions of the Spallation Model Benchmark organized at the present time by IAEA, but should be complemented by specific comparisons of the models to the available elementary data (part of them originating from HINDAS and NUDATRA) in the 150-600 MeV energy domain. The comparison of the models to elementary data will allow identifying their main deficiencies.The uncertainties on key parameters of the spallation target resulting from the uncertainties in the models will be estimated. The key parameters will include the spallation neutron yield, total activity and major contributors to the activity of the target and structure materials, production rate of helium (mostly for material damage assessment) and of radioactive gases, in particular tritium, and volatile elements from the liquid target. The results of this task will be discussed with end-users, in particular the MYRRHA/CDT team, in order to define on which points the effort on model improvement should be focused.

[4] Please indicate one activity per work package:
RTD = Research and technological development (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities – only possible for Collaborative projects);
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Task 4.2 SPALADIN p+Pb at 500 MeV: measurement of the fission fragments and evaporation residues in coincidence with light ions (*Task Leader*: USC, *Participants*: GSI, CEA/DSM)

Inconsistencies between different sets of experimental data have been pointed out during the NUDATRA project and the IAEA Benchmark. This makes it difficult to know the best data to use for assessing the predicting capability of a model. This concerns in particular the isotopic distribution of fragments in p+Pb at 500 MeV, which is essential for the assessment of radioactivity release from the liquid metal target during and after operation: the experiment done in the framework of NUDATRA has shown that the total fission cross-section found in a previous FRS experiment was very likely not correct but it is not known if the fragment distribution can just be renormalized or not. The SPALADIN fission experiment on p+Pb at 500 MeV, in which the two fission fragments and light evaporation residues produced in coincidence with neutrons and light ions will be measured, will allow solving this puzzle by giving at the same time the total fission cross-section and the charge distribution. In addition, will provide helium and intermediate mass fragment production cross-sections in an energy domain where data are scarce. The experiment, which uses the reverse kinematics technique at GSI (Darmstadt), is part of a wider program already accepted by the GSI PAC and is foreseen to be scheduled beginning of 2010.

Task 4.3 Measurement of neutron-induced light ion cross-sections at 175 MeV on Fe, Bi and U (*Task Leader*: UU, *Participants*: CNRS)

Tritium has been found to be one of the major radioprotection problems of spallation targets. Helium is also important for material damage in the window and structure materials. Data around 200 MeV, region corresponding to both the lower limit for the use of models and upper limit of evaluated data files (generated by TALYS) are very scarce. Using the Medley set-ups located at TSL (Uppsala), measurements of neutron induced light-ion production from Fe, Bi and U will be performed at 175 MeV. The uncertainty in the data will generally be in the 10% range. This is to be compared with an estimated uncertainty of 40-50% in current TALYS blind calculations in that region. Using the experimental results as guide, the TALYS uncertainties should be reduced by at least a factor of two, which is a significant improvement.

Task 4.4 Improving of the predicting capabilities of the models in the 150-600 MeV in order to reduce the uncertainties on key parameters of the demonstration facility spallation target (*Task Leader*: ULG, *Participants*: GSI, CEA/DSM, CEA/DAM, NRG)

The objective will be, once the main deficiencies in the models will have been identified, to work on their reduction. Model improvements will be concentrated on the curing of identified deficiencies having an impact on the prediction of key parameters of ADS demonstrators. The improved models or evaluated data files will be implemented into standard high-energy transport codes in order to assess the resulting reduction of uncertainty on key parameters of the ADS demonstrator. It will be checked with the end-users, in particular the MYRRHA/CDT team, that the remaining discrepancies between experiment and predictions are sufficiently small to only affect marginally the calculations of the key parameters of MYRRHA.

- **Sub-task 4.4.1:** Improving the high energy models (Sub-task Leader: ULG, Participants: GSI, CEA/DSM)

The starting point will be the INCL4 and ABLA models in the versions developed in NUDATRA. The specific features of the 150-600 MeV domain, for instance the importance of in-medium effects in INC models, neglected at higher energies will be studied. The description of low energy fission will be improved, for example by including the influence of N=50 shell, which at the moment is not considered. The even-odd contribution to the yield, which is at the moment too strongly predicted by ABLA, will also be studied. The even-odd staggering could affect the final production cross-sections even by 20-30% locally.The validation on the experimental data sets used in Task 4.1 and on results from Task 4.2 and 4.3 will be performed.

- **Sub-task 4.4.2:** Investigating the possibility to use evaluated data files above 150 MeV (Sub-task Leader: CEA/DAM, Participants: NRG)

The possibility to use High-Energy Evaluated Nuclear Data Files generated from the TALYS+BRIC reaction code instead of models will be investigated. A high-energy evaluated data files will be generated and benchmarked against experimental data.

Task 4.5 Validation on the results from the post irradiation analysis of MEGAPIE samples (*Task Leader*: PSI, *Participants*: CEA/DSM)

This task will concern the validation on an integral experiment, namely the MEGAPIE target which has been the first liquid metal spallation target irradiated by a 575 MeV proton beam successfully during 4 months. The target has been cut into disks after the cooling down period. Analysis of samples from the lead-bismuth eutectic, after extracting samples from the target pieces, will be performed and the results compared to simulation. The investigation will focus on the analysis of long-lived ß- or EC-emitters like ^{10}Be, ^{26}Al, ^{60}Fe, ^{59}Ni, ^{36}Cl, ^{129}I, ^{53}Mn and others as well as a-active isotopes of Po which are specific of lead-bismuth targets and a major problem for radioprotection. The expected achievements are: the characterisation of the radionuclide inventory of the ISOLDE target as model for MEGAPIE, the determination of the vertical and radial distributions of relevant radionuclides in MEGAPIE (without expansion tank), the investigation of the components of the expansion tank (heat exchanger, adsorber). The quality of the new models concerning the production of key isotopes in the MEGAPIE samples will be assessed and discussed with end-users.

Deliverables: *(brief description and month of delivery)*

D4.1 Report on the predicting capabilities of the standard simulation tools in the 150-600 MeV energy range (M12) (CEA/DSM)

D4.2 New versions of the INCL4 and ABLA models improved in the 150-600 MeV domain (report and codes) (M30) (ULG)

D4.3 Final high-energy evaluated data files and benchmarks comparison (M30) (CEA/DAM, NRG)

D4.4 Experimental results from the SPALADIN experiment on p+Pb at 500 MeV (report and EXFOR library)(M36) (USC)

D4.5 Light_ion production cross-sections from n+Fe, Bi and U at 175 MeV (report and EXFOR library) (M36) (UU)

D4.6 Report on the validation of the simulation tools developed in Task 4.4 and assessment of the expected reduction of uncertainty on key parameters of the ADS (M36) (CEA/DSM, PSI)

D4.7 Experimental results from the MEGAPIE sample analysis (Report and file) (M36)

Milestones: *(brief description and month of delivery)*

M4.1: Identification of the main deficiencies of the models to be corrected (M12)

M4.2: Realization of the Uppsala experiment (M12)

M4.3: Realization of the SPALADIN experiment (M18)

M4.4: Obtaining of the MEGAPIE samples (M18)

M4.5: Preliminary high-energy evaluated data files and benchmark comparison (M24)

M4.6: Analysis of the MEGAPIE samples (M30)

Work package 5 **Start date or starting event: month 1**

Work package title	Dissemination, education & training						
Activity Type[5]	OTHER						
Participant number	1	2	8	12	20		
Participant short name	CIEMAT	CEA/DSM	JRC/IRMM	NRG	UU		
Person-months per participant	3.2	0.8	0.6	1.1	1.3		

Coordinator: CIEMAT. Duration: 36 months

Objectives:

This WP will coordinate the activities on education and training to make sure that the PhD. Students and post-docs involved in the project find the adequate training in nuclear data but also in other aspects of the nuclear generation of electricity. The training opportunities from this project will be open to participants in related EU activities.

At the same time, the training together with the dissemination aspects should help to distribute the results and integrate in the interpretation and discussions of the results, a much wider community than the actual project partners. Large meetings open to the full EU nuclear data community will be organized with resources to support the participation of representing persons of End-Users organizations, and encouraging external scientific contributions.

Indeed, a special action will be launched to coordinate a wide group of End-Users by joining institutions participating at present or in the recent past in nuclear data, new reactor and advanced fuel cycle projects as well as respresentants of SNETP. Managers of experimental reactors and nuclear laboratories will also be invited to the End-Users group, to disseminate the characteristics of presently optimized facilites and required for the facilities of the following nuclear data projects. These End-Users will get access to the results produced in the project, will be invited to participate in the yearly general meeting to contribute to scientific and technical discussions, and will play a fundamental roll in the dissemination and utilization of the results. Special provision will be made within this work package to allocate financial support (travel costs and subsistence) from the project to cover their participation in the general meetings.

This End-Users group should also help as an instrument to keep relation with American, Japanese and Russian organizations (eventually using the ISTC or the Euratom-Rosatom co-operation agreement) and involved in the nuclear data development.

The training activities and general meetings will be combined with one of the previously existing conferences/workshop in nuclear data.

To facilitate the dissemination of ANDES results and the exchange of information within the project a Web site will be prepared and open by the project. All consolidated information will be fully open, but a restricted access area will be reserved for muterials under discussion within the project participants. Part of this restricted area will be open to the End-Users.

[5] Please indicate one activity per work package:
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DEM = Demonstration (only possible for Collaborative projects); MGT = Management of the consortium;
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Description of work: *(possibly broken down into tasks), and role of participants*

Task 5.1: Coordination of the education and training activities. (*Task Leader*: UU, *Participants*: CIEMAT)

The main objectives will be to promote that the research activities within the project result in PhD and Master theses and to organize one training course specialized in Nuclear Data for Sustainable Nuclear Energy open to the participants in other EU projects related to the field.

For this second objective the project will cooperate with the organizers of known schools on nuclear research to propose a special edition of their school mostly dedicated to the topics of the ANDES project. Initial contact with the organizers of the series of EXTEND (European course on EXperiment, Theory and Evaluation of Nuclear Data) schools and the experience of the CANDIDE project indicate the feasibility of this approach. No fee will be requested and financial support will be allocated to provide travel support to a fraction of the students.

Task 5.2: Coordination of the cooperation with NEA and IAEA and Dissemination activities: (*Task Leader:* NRG, *Participants*: JRC/IRMM)

The time between nuclear data measurement and regular utilization has been often far too long. This time was already reduced in the EUROTRANS-NUDATRA project by teams also participating in the ANDES project. Still, all possible means to accelerate the access and utilization of the new evaluated data, uncertainties and models are worth to make sure that they can contribute in the new designs of sustainable nuclear systems and in the associated technological choices. The first step for dissemination is to distribute the nuclear data. This is done by their incorporation into one of the nuclear data bases distributed by international centers, particularly, NEA/OECD or IAEA. This task will coordinate the most effective distribution of the data, uncertainties and models by these international organizations and their publication and presentation in scientific journals and international conferences. Active members of the project within the related expert groups of NEA and IAEA will lead his coordination.

The second factor for dissemination is bringing data close to the End-Users, covered in the following task. The Web site will also be used for dissemination of the ANDES results.

A Disemination and Use plan will be prepared early in the project to help all participants planning the visibility of their contributions.

Task 5.3: Coordination and support to End-Users group (*Task Leader*: CEA, *Participants*: CIEMAT, JRC and NRG)

The special action will gather an End-Users group with two types of participants: nuclear data groups not participating directly in the project and industries and designers involved in the preparation of sustainable nuclear systems or fuel cycles.

The group will include the nuclear data groups, involved in the present experimental campaigns that cover the measurements or integral experiments proposed in ANDES, but not participating directly in the project (e.g. more than 10 institutions of the present nTOF experiment) and the institutions participating in other present or recent nuclear data projects (nTOF_ND-ADS, HINDAS, NUDATRA, CANDIDE, EFNUDAT and EUFRAT) projects. These teams can very efficiently contribute to the interpretation of the new results and to their dissemination, enhancing the impact of the ANDES results.

In addition, managers of experimental reactors and nuclear laboratories will also be invited to the End-Users group. Their participation will allow disseminating the characteristics of facilities selected for the ANDES projects, illustrating why they were the best solutions for each measurement. The discussion of the project activities and projection to future experiments, will allow those facilities to optimize their design and become more competitive for future projects.

In addition, the industries and designers involved in the preparation of sustainable nuclear systems or advanced fuel cycles will receive information and help to use the new data and methods. Their feedback and advices will be taken into account along the execution of the project. Particular attention will be taken to involve the participants on the FP7 projects studying the different Gen-IV and ADS systems (CDT, ESFR,…). The participation of ANDES institutions on all these projects will facilitate this connection. Special attention will also be paid to the participation of the Sustainable Nuclear Energy Technological Platform (SNE-TP) and the associated European Industrial Initiative. Again the fact that several institutions of the project are member of the SNE-TP and the project coordinator is member of its Executive Committee will easy the co-operation.

This End-Users group should also help as an instrument to keep relation with American, Japanese and Russian organizations (eventually using the ISTC or the Euratom-Rosatom co-operation agreement) and involved in the nuclear data development.

These End-Users will get early access to the results produced in the project and will be invited to participate in the yearly general meeting to contribute to scientific and technical discussions. Special provision will be made within this work package to allocate financial support (travel costs and subsistence) from the project to cover their participation in the general meetings.

One general meeting per year will be organized with support for the participation of End-Users.

Deliverables: *(brief description and month of delivery)*

D5.1 Disemination and Use plan (M12) (NRG, JRC, CIEMAT)

D5.2 One Open Training course (M30) (UU)

D5.3 Report on dissemination activities (M36) (NRG)

D5.4 Final report on the activities of End-Users group (M36) (CEA)

Milestones: *(brief description and month of delivery)*

M5.1: First meeting of the End-users group (M12)

Work package 6 **Start date or starting event: month 1**

Work package title	Management						
Activity Type[6]	MGT						
Participant number	1	2	12				
Participant short name	CIEMAT	CEA/DSM	NRG				
Person-months per participant	3.4	0.7	0.7				

Coordinator: CIEMAT. Duration: 36 months

Objectives:

This WP will be dedicated to the general management of the project and its coordination with other ongoing EC projects in the field of advanced nuclear systems: reactors, ADS and their fuel cycles. Special attention will also be paid to coordinate with the working groups on nuclear data from the NEA/OECD (several participants of the project are active members of the working parties) and the IAEA (also several members of the project are active members of the agency activities and of the nuclear data related coordinated research projects - CRPs).

Description of work: *(possibly broken down into tasks), and role of participants*

Task 6.1: Management of the project (*Task Leade*r: CIEMAT, *Participants*: CEA and NRG)

This task will handle the Management of the consortium, including the administrative and financial operations, the preparation of the consortium agreement, the draft version for the rules of operation of the different management bodies described in the section III.1 and the reporting to the EU. One specific objective will be the coordination of the final report of the project.

To facilitate the dissemination of ANDES results and the exchange of information within the project a Web site will be prepared and open by the project. All consolidated information will be fully open, but a restricted access area will be reserved for materials under discussion within the project participants. Part of this restricted area will be open to the End-Users. The image of the web site at the end of the project will be recorded in a DVD ready for distribution.

Deliverables: *(brief description and month of delivery)*

D6.1 Final version of the ANDES web (M36) (CIEMAT)

D6.2 Final report of the project (M36) (CIEMAT)

Milestones: *(brief description and month of delivery)*

M6.1: Creation and opening of the ANDES web (M6)

[6] Please indicate one activity per work package:
RTD = Research and technological development (including any activities to prepare for the dissemination and/or exploitation of project results, and coordination activities – only possible for Collaborative projects);
DEM = Demonstration (only possible for Collaborative projects); MGT = Management of the consortium;
COORD = Coordination activities (for Coordination Actions); SUPP = Support activities (for Support Actions); OTHER = Other specific activities (including training), if applicable

B 1.3.6. Efforts for the full duration of the project

Participant no. / short name	**WP1**	**WP2**	**WP3**	**WP4**	**WP5**	**WP6**	**Total person months**
CIEMAT	26.8	8.9	17.8	0.0	**3.2**	**3.4**	60.1
CEA	26.0	24.9	**35.3**	**35.3**	0.8	0.7	123.0
CNRS	82	0.0	23	2	0.0	0.0	107.0
GSI	0.0	0.0	0.0	18.8	0.0	0.0	18.8
IFIN-HH	33.3	0.0	0.0	0.0	0.0	0.0	33.3
INFN	28.1	0.0	0.0	0.0	0.0	0.0	28.1
ITN	10.0	0.0	0.0	0.0	0.0	0.0	10.0
JRC	**46.7**	0.0	0.0	0.0	0.6	0.0	47.3
JSI	0.0	0.0	40.1	0.0	0.0	0.0	40.1
JYU	16.7	0.0	0.0	0.0	0.0	0.0	16.7
NNL	0.0	10.2	0.0	0.0	0.0	0.0	10.2
NRG	0.0	**19.9**	11.1	3.0	1.1	0.7	35.8
PSI	0.0	0.0	0.0	15.7	0.0	0.0	15.7
SCK-CEN	0.0	0.0	6.9	0.0	0.0	0.0	6.9
TUW	0.0	20.7	0.0	0.0	0.0	0.0	20.7
UB	0.0	14.5	0.0	0.0	0.0	0.0	14.5
ULG	0.0	0.0	0.0	18.8	0.0	0.0	18.8
UPM	0.0	28.6	0.0	0.0	0.0	0.0	28.6
USC	1.7	0.0	0.0	29.5	0.0	0.0	31.2
UU	0.0	0.0	0.0	11.3	1.3	0.0	12.6
Total	**271.3**	**127.7**	**134.2**	**134.4**	**7.0**	**4.8**	**679.4**

Activity Type	CIEMAT	CEA	CNRS	GSI	IFIN-HH	INFN	ITN	JRC	JSI	JYU	NNL	NRG	PSI	SCK-CEN	TUW	UB	ULG	UPM	USC	UU	TOTAL ACTIVITIES
RTD/Innovation activities																					
WP 1	26.8	26.0	82.0	0.0	33.3	28.1	10.0	46.7	0.0	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	271.3
WP 2	8.9	24.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.2	19.9	0.0	0.0	20.7	14.5	0.0	28.6	0.0	0.0	127.7
WP 3	17.8	35.3	23.0	0.0	0.0	0.0	0.0	0.0	40.1	0.0	0.0	11.1	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	134.2
WP 4	0.0	35.3	2.0	18.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	15.7	0.0	0.0	0.0	18.8	0.0	29.5	11.3	134.4
Total 'research'	**53.5**	**121.5**	**107**	**18.8**	**33.3**	**28.1**	**10**	**46.7**	**40.1**	**16.7**	**10.2**	**34**	**15.7**	**6.9**	**20.7**	**14.5**	**18.8**	**28.6**	**31.2**	**11.3**	**667.6**
Demonstration activities																					
Total 'demonstration'																					
Consortium management activities																					
WP 6	3.4	0.7										0.7									4.8
Total ' management'	**3.4**	**0.7**										**0.7**									**4.8**
Other activities																					
WP 5	3.2	0.8						0.6				1.1								1.3	7.0
Total 'other'	**3.2**	**0.8**						**0.6**				**1.1**								**1.3**	**7.0**
TOTAL BENEFICIARIES	60.1	123.0	107	18.8	33.3	28.1	10	47.3	40.1	16.7	10.2	35.8	15.7	6.9	20.7	14.5	18.8	28.6	31.2	12.6	679.4

Project effort form 2: Indicative efforts per activity type per beneficiary in person-months.

B 1.3.7. List of milestones and planning of reviews

Milestone number	Milestone name	Work package(s) involved	Lead beneficiary	Expected date	Comments
	Work package 1				
M1.1	Processing of ^{241}Am total and radiative neutron capture measurements at IRMM	WP1	JRC	12	Brief report to the coordinator
M1.2	Measurements for the ^{238}Pu fission cross section by the transfer method	WP1	CNRS/ CENBG	12	Brief report to the coordinator
M1.3	Analysis of n_TOF ^{241}Am, ^{243}Am and ^{245}Cm fission cross section data	WP1	INFN	12	Brief report to the coordinator
M1.4	Measurements of the ß-decay of the ^{88}Br, ^{94}Rb, ^{95}Rb and ^{137}I isotopes with a total absorption spectrometer	WP1	JYU	12	Brief report to the coordinator
M1.5	Measurements of inelastic scattering off ^{238}U	WP1	CNRS/ IPHC	18	Brief report to the coordinator
M1.6	Methodology implementation for covariance generation for (n,nγ) measurements	WP1	IFIN-HH	18	Brief report to the coordinator
M1.7	Measurements of fission yields with VAMOS at GANIL	WP1	CNRS/ GANIL	18	Brief report to the coordinator
M1.8	Measurements of neutron inelastic scattering off non-actinide components	WP1	JRC/ IRMM	24	Brief report to the coordinator
M1.9	Measurements ^{241}Am radiative neutron cross section at the n_TOF facility	WP1	CIEMAT	24	Brief report to the coordinator
M1.10	Measurements for the Cm capture cross section by the transfer method	WP1	CNRS/ CENBG	24	Brief report to the coordinator
M1.11	New measurements of fission cross sections for ^{240,242}Pu at CENBG	WP1	CNRS/ CENBG	24	Brief report to the coordinator
M1.12	New measurements of fission cross sections for ^{240,242}Pu at the JRC-IRMM VdG laboratory	WP1	JRC/ IRMM	24	Brief report to the coordinator
M1.13	New measurements of fission cross sections for ^{240,242}Pu at n_TOF	WP1	INFN	24	Brief report to the coordinator
M1.14	Measurements of the ß-decay of the ^{88}Br, ^{94}Rb, ^{95}Rb and ^{137}I isotopes with neutron detectors	WP1	CIEMAT	24	Brief report to the coordinator
M1.15	Measurements of the ^{238}U total and radiative neutron capture cross sections at IRMM.	WP1	JRC/ IRMM	34	Brief report to the coordinator
M1.16	Measurements of the ^{238}U total and radiative neutron capture cross sections at nTOF	WP1	CEA/DSM	34	Brief report to the coordinator
	Work package 2				
M2.1	Report on extension of GENEUS code package including TALYS++.	WP2	TUW	24	Report
M2.2	Report on the usability of Monte Carlo uncertainty propagation in fuel cycle codes, and comparison with conventional approach	WP2	UPM/ UNED	24	Report

M2.3	An upgraded ACAB code, which now will deal with cross-channel and cross-nuclide correlations	WP2	UPM/ UNED	24	Presentation of new ACAB capabilities at ANDES and related meetings
M2.4	New computational method for the use of covariance information of reaction, decay and fission yield data in an inventory calculation	WP2	NNL	24	Presentation at ANDES and related meetings
M2.5	A new release of CONRAD	WP2	CEA/DEN	36	Presentation at the Andes and JEFF meeting, release to NEA Data Bank
M2.6	A new release of TALYS, publicly available on the TALYS website	WP2	NRG	36	Publication of new TALYS version on www.talys.eu
	Work package 3				
M3.1	Description of the part of the PROFIL experiment made in PHENIX reactor	WP3	CEA/DEN	6	Report
M3.2	Description of the part of the VENUS-F core (GUINEVERE) experiment	WP3	SCK-CEN	6	Report
M3.3	Code developments to implement the methodology	WP3	CEA/DEN	12	Software released
M3.4	Interim comparison on the analysis of different systems	WP3	CEA/DEN	18	Seminar
M3.5	Final comparison on the analysis of different systems	WP3	CNRS	26	Report D3.7
M3.6	Feedback on nuclear data	WP3	CNRS	32	Seminar
M3.7	Impact of the new Covariance coming from WP2 to the analysis of the different experiments	WP3	CEA/DEN	36	Report D3.8
	Work package 4				
M4.1	Identification of the main deficiencies of the models to be corrected	WP4	CEA/DSM	12	Report
M4.2	Realization of the Uppsala experiment	WP4	UU	12	Short communication to coordinator
M4.3	Realization of the SPALADIN experiment	WP4	USC	18	Short communication to coordinator
M4.4	Obtaining of the MEGAPIE samples	WP4	PSI	18	Short communication to coordinator
M4.5	Preliminary high-energy evaluated data files and benchmark comparison	WP4	CEA/DSM	24	Report
M4.6	Analysis of the MEGAPIE samples	WP4	PSI	30	Communication to coordinator
	Work package 5				
M5.1	First meeting of the End-users group	WP5	NRG	12	Minutes
	Work package 6				
M6.1	Creation and opening of the ANDES web	WP6	CIEMAT	6	Web

The distribution of milestones is shown in the Gant chart at B1.3.2. About half of the milestones take place before month 18, so the first project review is proposed after month 18th, and the second one at the end of the project, see table below.

Tentative schedule of project reviews			
Review no.	**Tentative timing, i.e. after month X = end of a reporting period** [7]	***planned venue of review***	***Comments , if any***
1	After project month: 18	Brussels	
2	After project month: 36	Brussels	

[7] Month after which the review will take place. Month 1 marking the start date of the project, and all dates being relative to this start date.

B 2. Implementation

B 2.1. Management structure and procedures

The organization structure of the ANDES Consortium comprises the following main bodies, see figure 3:

- Governing Board is the uppermost decision-making and arbitration body of the Consortium. Each partner has one voting representative to the Governing Board. The Chairperson will be elected during the Kick-off Meeting which will take place at the latest one month after start of the project. The coordinator will not stand for election of the chair person.
- Executive Committee, as the supervisory body for the project execution will have the responsibilities for implementing the general policy and strategic orientations decided on by the Governing Board, for establishing the Project Deliverables for the Commission, and for preparing progress reports of the Project for the Commission and the Governing Board. The Executive committee will guarantee the integration of the activities and the coordination of the technical activities. It is composed of the the Work Package leaders, the responsible for the monitoring of international initiatives, and the responsible for the interface with the End-Users group and is chaired by the project Co-ordinator.
- End-Users group is a body composed by design specialists of industry, of current EC and national projects on Gen IV and transmutation systems, by representatives of the international organizations involved in the nuclear data distribution like NEA/OECD and IAEA and other nuclear data groups. The End-Users group will benefit early from the project results, formulates specific requirements on the distributed nuclear data and provides scientific and technical advice on specific areas of interest. In this way it will ensure the exploitation of results and contribute to the dissemination of knowledge within the involved organizations and beyond. The Agreement with the End-Users group participants will be specified during the first year of the project.
- The Co-ordinator as the intermediary to the European Commission is authorised to execute the project management, chairs the Executive Committee and reports and is accountable to the Governing Board.
- Training: The Executive committee will directly follow the progress and quality of the training activities organized by WP5.

Organizational Levels: The management structure of ANDES has two levels: the Governing Board and the Executive Committee. This structure focuses responsibilities and channels information. For each of the two levels, the taking of decisions, the dissemination of results, and the exchange of information is clearly identified and controlled by people and bodies.

This structure concentrates responsibilities for day-to-day management in the Executive Committee, which is accountable to the Governing Board. In the Governing Board all partners have their voice and vote to influence in the strategic and financial decisions and to provide detailed guidance for the Executive Committee.

Critical situations: The management structure in organizational levels allows the Executive Committee to detect unexpected developments and critical situations, which might occur during the lifetime of the Project and which might endanger to planned course of activities, so early that the Co-ordinator and the Responsible Committees are able to react flexibly and to take the appropriate actions.

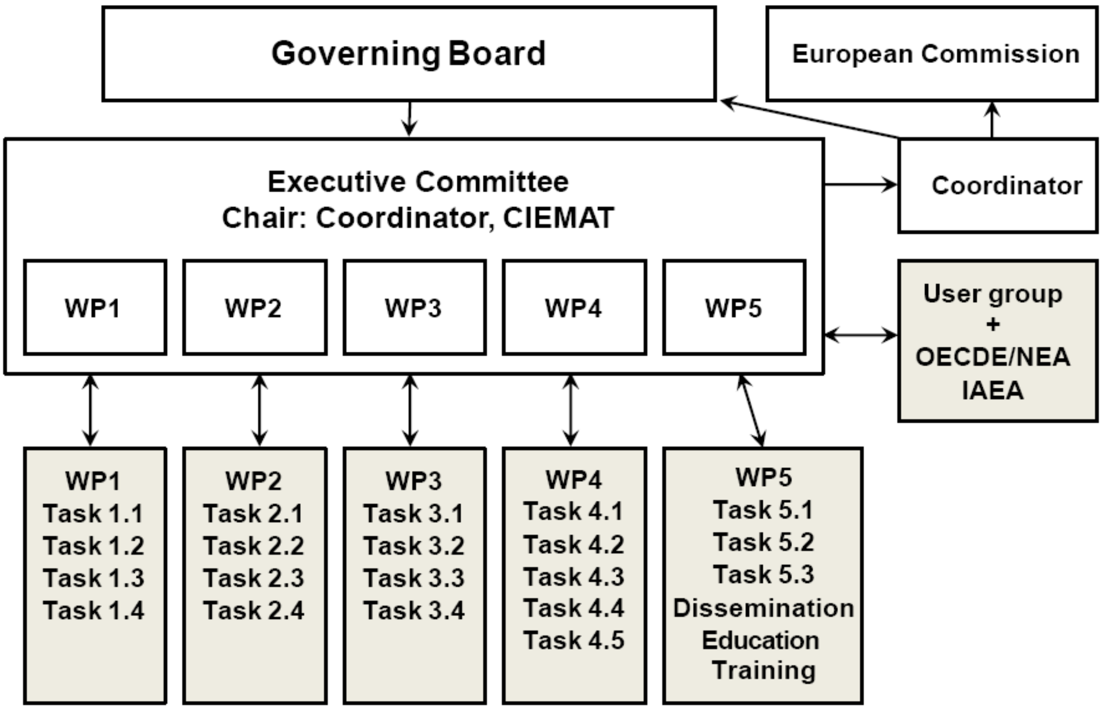

Figure 3: Management structures

Governing Board

The Governing Board is the ultimate decision-making body of the Consortium. It decides on matters relating to:

- Ø the preparation and final approval of the annual management reports related to financial statements and technical advancement of the project prior to the submission to the EC,
- Ø all budget-related matters,
- Ø the acceptance of new partners as well as the exclusion of partners,
- Ø the structure and restructuring of the Work packages,
- Ø proposals to the partners for the alteration of the Consortium Agreement,
- Ø proposals to the partners for the premature completion / termination of the project.
- Ø Approval of End-Users group agreement

The Governing Board meets on a regular schedule this being at least every 18 months. In due time before this meeting it is anticipated to have an Executive Committee meeting, in order to provide all technical issues needed. If needed and upon request of the Executive Committee, the Governing Board calls for extraordinary meeting.

Executive Committee

The Executive Committee is the supervisory body for the execution of the project. The important activities of the Executive Committee include:

- Ø Proposing the scientific orientations to the Governing Board and implement the agreed orientations
- Ø Ensuring the scientific monitoring and review progress of the research work, the training activities, and the initiation of actions in case of failure of individual contractors,
- Ø Approval of the work schedules and co-ordination of the work programmes within and between the technical work packages,
- Ø Preparation, where necessary, of revisions to the detailed work programmes,
- Ø Preparation of multi-purpose use of projects instruments, such as workshops, topical meetings, etc.

- Ø Identification of potential problems and/or issues that need to be referred to the Governing Board,
- Ø Identification of technical developments which are related to patents and the development of design, component, or process issues,
- Ø Schedule meetings supporting the effective conduct of the work programme,
- Ø Review and approve the contractually required reports and Deliverables,
- Ø Resolve issues referred to the Executive committee by the partners.
- Ø Under the control of, and in compliance with the decisions of the Governing Board, the Executive Committee will coordinate, analyse and approve the results generated under the Work Packages.
- Ø Contribution to management reports,
- Ø Contribution to activity and financial reports
- Ø Proposals on tasks to be conducted and the arrangements for performance and orientation of the Work Packages,
- Ø Inform the Governing Board concerning contractors presenting financial or technical difficulties within a Work Package,
- Ø Information of any other difficulty arising in connection with the conduct of the Work Packages,
- Ø Proposals on any publication/communication.
- Ø Prepares the agreement and establish the link with the End-Users group

The Executive committee meets on a regular schedule, being at least every six months. Before these meetings it is anticipated to have work packages technical meetings, in order to provide all technical issues needed.

End-Users group

The End-Users group is composed of selected European universities, representatives of R&D organisations, international nuclear data agencies OECD/NEA and IAEA, industries involved in pertinent design activities, regulatory bodies and education representatives. The End-Users group will:

- Ø Benefit early from the project results, formulate specific requirements on the distributed nuclear data and provide scientific and technical advice on specific areas of interest.
- Ø Ensure the exploitation of results and contribute to the dissemination of knowledge within the involved organizations and beyond;
- Ø Collective and consensual appraisal on the limits and potentialities of the nuclear data, evaluation tools and generated knowledge for the Gen II(+), Gen-IV and transmutation systems;
- Ø Foster the interaction between the partners, R&D groups and the International nuclear data agencies OECD/NEA and IAEA;
- Ø Help to keep relation with American, Japanese and Russian organizations.

The End-Users group will be set-up during the first year of the project. A collaboration agreement will be defined and submitted to the participants of the End-Users group. The travel and subsistence costs of scientists of the End-Users group for their participation in technical meetings will be financed partially through the ANDES project budget.

Project Co-ordinator

The project Co-ordinator assisted by the Executive Committee is responsible for the overall (technical and financial) management of the project. Moreover the Co-ordinator will:

- Ø Act as the contact for the EC,
- Ø Act as the intermediary between all participants and the EC, since all information related to the project will be transmitted to the EC through the project Co-ordinator,

- Establish the contracts with the partners,
- Receive all payments made by the EC and administering the EC contribution,
- Process the invoicing, and exercising the payment to all project partners,
- Inform he EC of the distribution of payments to the partners,
- Establish provisions for support for the Governing Board and the Executive Committee, and respective meetings,
- Establish and update the project Web site, the contractors' address lists, etc.,
- Organize registration and central deposit of all documents prepared under the project,
- Prepare and submit the contractually required periodic activity and financial reports; supplementary reports as far as necessary,
- Prepare the Consortium Agreement which regulates the internal organisation and management of the consortium,
- Handle all other administrative and financial matters related to the project contract,
- At present no subcontracting of activities has been foreseen. However, in the case of necessity: prepare and publish of calls for tenders in case of competitive calls for new contractors, pre-evaluation of the proposals and negotiation of contracts,
- Act as a focal point for all kinds of project external and internal requests.

B 2.2. Beneficiaries

Centro de Investigaciones Energéticas MedioAmbientales y Tecnológicas (CIEMAT)

The CIEMAT, an Organism of the Ministry of Science and Innovation, is a Public Research Agency for excellence in energy and environment, as well as in many vanguard technologies and in various areas of fundamental research.

The group involved in the project is the Nuclear Innovation Unit of the Nuclear Division, belonging to the Energy Department. The group works in nuclear data research since its formation in 1997, participating in the EU projects nTOF-ND-ADS of FP5 and the CANDIDE network of FP6 and coordinating the NUDATRA Domain of IP-EUROTRANS. It has also participated in the nuclear data experiments nTOF at CERN, at the JRC-IRMM and the preparation of experiments at FAIR. The nuclear data activity is part of a wider research program on nuclear advanced nuclear cycles including the nuclear waste transmutation and advanced reactors for sustainable nuclear energy. The group has contributed to the project FEAT and TARC (FP4) experiments at CERN, the MUSE4, PDS-XADS y ADOPT of FP5; in EUROTRANS, PATEROS, RED-IMPACT, JHR-CA, MTR-I3 and SNF-TP of FP6; CP-ESFR, CDT and FAIRFUELS of FP7 as well as several ISTC projects. Other groups of CIEMAT have participated in different FP projects on Partitioning, Geological repository, Nuclear Safety and Material for nuclear applications. The Nuclear innovation group also participates in the NEA Working Party on scientific issues of Advanced Fuel Cycles, WPFC previously WPPT, and in several expert groups of IAEA. Finally CIEMAT is founder member of the Sustainable Nuclear Energy Technological Platform, SNETP, with representation on the Governing Board and on the Executive committee.

CIEMAT will contribute with the experience in nuclear data measurements at nTOF where it is responsible for the actinides capture measurements. The recent nTOF measurements of ^{237}Np and ^{240}Pu were coordinated by CIEMAT and have provided the best sets of data available.

CIEMAT participates in several international research projects and expert groups on advanced fuel cycles and their influence in the nuclear waste management. CIEMAT has developed the EVOLCODE2 system designed to simulate any type of advanced fuel cycle. Together with UNED and UPM, CIEMAT has prepared a version of EVOLCODE2 combined with ACAB able to propagate the uncertainties in the simulations, taking into account any form of covariance matrices.

CIEMAT has developed the experimental experience in fast critical and subcritical systems within the experimental facilities MASURCA and YALINA, developing methodologies for reactivity monitoring and specific measurement technologies.

Finally, its participation in RED-IMPACT, PATEROS, CANDIDE, WPFC and SNETP provided this team with the know-how and experience to identify the relevance and potential impact of the progress in nuclear data for the reactor systems, its fuel cycle and the final disposal. Recently CIEMAT has coordinated the NUDATRA evaluation of nuclear data needs for advanced fuel cycles with multiple recycling and using Partitioning and Transmutation technologies.

CIEMAT key participants in the projects include:

E. Gonzalez-Romero, PhD in Physics, head of the Nuclear Fission Division, coordinator of the NUDATRA Domain of IP-EUROTRANS, Chairman of the nTOF collaboration Board and its general Spokesperson, Deputy-chairman of the SNETP Executive Committee, member of the WPFC/NEA, and contributor to all the FP4, FP5 and FP6 projects of the Nuclear Innovation Unit. He will act as coordinator

D. Cano-Ott, PhD in Physics, responsible for the nuclear data activities of the Nuclear Innovation Unit and of the actinide capture measurements at nTOF. He has participated in most of the FP6 nuclear data projects of the Unit. He has recently supervised a PhD and various Master Theses in nuclear data completed in 2008. He will participate and be the contact person for the WP1.

D. Villamarin, PhD in Physics, responsible of the experimental activities in the experimental reactors, MASURCA and YALINA, and taking part in the preparation of the GUINEVERE experiments in VENUS-F experimental program. He will be the contact person for WP3 of ANDES.

F. Alvarez, Nuclear Physicist, author of the EVOLCODE2 system and participant in NUDATRA evaluation of nuclear data needs. He will be the contact person for WP2 of ANDES.

Commissariat à l'Energie Atomique (CEA)

The Commissariat à l'Energie Atomique (CEA) is a science and engineering research institution, funded by the French Government and industrial contractors. The CEA is organized in four research and development sectors: nuclear energy (DEN), technological research (DRT), fundamental research (DSM and DSV) and defense (DAM). The nuclear energy programs are devoted to the support for nuclear power stations in operation, design of systems for the future (in particular Gen-IV reactors), studies for waste management and dismantling of obsolete installations. CEA has recognized and long scientific and technological experience in the field of nuclear data. The synergy between its different components allows CEA covering all the aspects of nuclear data: fundamental measurements, theory, integral measurements, evaluation, simulation code development and validation.

In the area of nuclear energy, the research is primarily being conducted by the teams of the Nuclear Energy Division (DEN). Within DEN, the Simulation and Experimental Tools Division (DSOE) is the Program Division in charge of the strategy, development and follow-up of basic research, simulation tools and associated experimental facilities which are necessary as a support for present and future nuclear power plants. One of them is the Simulation Program of DEN which aims at improving the legacy codes (such as APOLLO, CRONOS, ERANOS, TRIPOLI, CATHARE, FLICA,…) and developing a new generation of codes. This program includes the development of predictive physical models, advanced numerical techniques, new software architectures, experimental validation of the calculations and basis data improvement. In the neutronic field of this Simulation Program, an important amount of work has been done, and is on going, to provide improved Nuclear Data to JEFF community and to developed new evaluation code CONRAD. In the same time several dedicated integral experiments are performed to assess the neutronic behaviors of different types of reactor cores: PWR (Pressurized Water Reactor), BWR (Boiled Water Reactor), SFR (Sodium cooled Fast Reactor), GFR (Gas cooled Fast Reactor) …

The following key experts will be involved in ANDES:

- C. De Saint Jean (Head of the nuclear data project in CEA/DEN): he will be the coordinator of the CEA/DEN activities in WP2. He is also in charge of the CONRAD code development.

DSM, the Physical Sciences Division, conducts fundamental research in the fields of energy, climate, fundamental laws of the Universe, condensed matter and nanoscience. The IRFU (Institut de Recherches sur les lois Fondamentales de l'Univers) is responsible for experimental and theoretical research in nuclear and particle physics, astrophysics, and instrumentation (see also: http://www.irfu.cea.fr). The nuclear physics division (SPhN) plays a leading role in developing instrumentation and carrying out research at several European facilities. It conducts a program of basic research on nuclear reactions involving neutrons, photons and protons over a wide energy range. SPhN groups have also recognized experience in the modeling of nuclear reactions, validation and benchmarking of reaction models for applications to nuclear energy, transmutation of nuclear waste, non-proliferation, non-destructive characterization of waste packages, design-decommissioning of nuclear installations, nuclear medicine, etc..

The following key experts will be involved in ANDES:

- S. Leray: Directeur de Recherche CEA, leader of the group SPALLATION working on experiments, modeling and validation in spallation physics, will be the coordinator of WP4. She has participated into the FP5 HINDAS project, was WP leader in

EUROTRANS/NUDATRA, co-Chair of the International Conference on Nuclear Data, ND2007, in Nice. She is presently organizing a Benchmark of Spallation Models with IAEA.

- F. Gunsing: group leader at CEA Saclay. He is an experimental physicist and working on neutron induced reactions in projects at both JRC-IRMM and at n_TOF at CERN. He participated earlier in FP5 (n- TOF-ND-ADS) and FP6 (IP_EUROTRANS/NUDATRA). His group will be involved in WP1.

The CEA DAM (Direction des Applications Militaires or Division of Military Applications) is primarily involved in defense applications like the French Simulation program. The development of the Simulation program relies on extensive modeling of physical processes as well as systematic experimental validation of each of the individual models with laboratory experiments. That effort encompasses the fields of nuclear physics and nuclear data which are relevant to the ANDES project as it was for the HINDAS, EUROTRANS/NUDATRA, CANDIDE and EFNUDAT projects. CEA DAM also provides evaluated nuclear data files to the JEFF project jointly with CEA DEN and collaborates with NRG on the development of the TALYS nuclear reaction code.

The section of CEA DAM involved in ANDES is the Service de Physique Nucléaire of the CEA DIF (DAM Ile-de-France) [Nuclear Physics News Vol.18, No 4, 2008, p. 5].

The following key experts will be involved in ANDES:

- E. Bauge (Head of Laboratory) specialized in the modeling of direct nuclear reactions and nuclear data covariances.
- P. Dossantos-Uzarralde, specialist of the formatting and validation of nuclear data as well as of the modeling of nuclear data covariances.
- H. Duarte, specialist of the modeling of high energy nuclear reactions.
- H. Goutte, specialist of the ab-initio modeling of the fission process.

Centre National de la Recherche Scientifique (CNRS-IN2P3)

The Centre National de la Recherche Scientifique (National Center for Scientific Research) is a government-funded research organisation, under the administrative authority of France's Ministry of Research.

CNRS's annual budget represents a quarter of French public spending on civilian research. As the largest fundamental research organization in Europe, CNRS carried out research in all fields of knowledge, through its seven research institutes : Mathematics (INSMI), Physics (INP), Chemistry (INC); Life Sciences (INSB); Humanities and Social Sciences (INSHS); Environmental Sciences and Sustainable Development (INEE); Information and Engineering Sciences and Technologies (INST2I); and its two national institutes: the National Institute of Earth Sciences and Astronomy(INSU); and the National Institute of Nuclear and Particle Physics (IN2P3).

Its own laboratories as well as those it maintains jointly with universities, other research organizations, or industry are located throughout France, but also overseas with international joint laboratories located in several countries. Measured by the amount of human and material resources it commits to scientific research or by the great range of disciplines in which its scientists carry on their work, the CNRS is clearly the hub of research activity in France. It is also an important breeding ground for scientific and technological innovation.

The IN2P3 is the National Institute of Nuclear Physics and Particle Physics of the CNRS. IN2P3 devotes itself to research in the physics of the infinitely small, from the atomic nucleus down to the elementary particles, and of the physics of the infinitely large, to study the composition and evolution of the Universe. The objectives are to determine matter's most elementary constituents and understand their interactions, and to understand the structure and properties of nuclei. It participates to the four big experiments, which are going to take place at the LHC of the CERN (Atlas, CMS, Alice and LHCb). In the field of data processing, IN2P3 is one of the leaders of the French Grid effort and is deeply involved in the European Computation grid projects aimed at optimum use of powerful, distributed computing facilities. IN2P3 leads a program of application of nuclear methods in medical imaging and environmental sciences. On behalf of CNRS, it pilots the interdisciplinary programme PACEN on future fission nuclear energy and its backend.

IN2P3 Laboratories such as IPHC in Strasbourg, IPNO in Orsay, CENBG in Bordeaux, GANIL in Caen, LPC Caen, or LPSC in Grenoble have teams working in the domain of the ANDES project; these teams have developed original research in the curse of the previous Framework Programs.

CNRS will participate in the workpackages WP1, WP2 and WP4. For the WP4, CNRS will participate in collaboration with the UNIVERSITE CAEN Basse Normandie, through their Joint Research Unit (JRU) of LPC Caen.

The beneficiary, CNRS, wishes to represent the UNIVERSITE CAEN Basse Normandie. So CNRS needs to insert clause 10 to the Grant Agreement, allowing them to show the participation of this member of the JRU. This Special Clause 10 is included in paragraph B.2.3.2.

GSI Helmholtz Centre for Heavy-Ion Research (GSI)

The GSI Helmholtz Centre for Heavy-Ion Research, founded by the Government of the Federal Republic of Germany and the State of Hessen, runs an accelerator facility for ion beams that is unique world-wide. The GSI research program comprises a broad spectrum ranging from nuclear physics, plasma physics, and materials research to tumor therapy. With the available accelerator and experimental facilities, GSI offers excellent and partly unique opportunities for research on incineration and transmutation of nuclear waste. A new technique, based on the use of inverse kinematics, has been developed at GSI, which allows identifying all short-lived radioactive nuclei produced as spallation residues prior to beta decay. In 1995 GSI joined the concerted action “Lead for ATD”. Under the 5th Framework Programme, GSI was involved in the HINDAS project: "High and Intermediate energy Nuclear Data for Accelerator driven Systems" and has gained a high experience level on this research topic. Under the 6th Framework Programme, GSI took part to IP-EUROTRANS, working both on experiments and calculations for high-energy nuclear data for ADS.

Horia Hulubei National Institute of Physics and Nuclear Engineering (IFIN-HH)

The Horia Hulubei National Institute of Physics and Nuclear Engineering (IFIN-HH) is one of the most important R&D organizations in Romania, contributing with almost 10% to the national scientific output. The institute is dedicated to the research and development in physical and natural sciences, mainly Nuclear Physics and Nuclear Engineering, and in related areas including Astrophysics and Particle Physics, Field Theory, Mathematical and Computational Physics, Atomic Physics and Physics of Condensed Matter, Life and Environmental Physics. In all these fields, IFIN-HH conducts theoretical and experimental research.

IFIN-HH operates two accelerators: a 9 MV TANDEM accelerator and a cyclotron capable of producing intense beams at 13 MeV/amu. These are mainly used for nuclear structure and atomic physics studies but also for applied research. Other facilities of the institute are the Radioactive Waste Treatment Plant (STDR), the IRASM center for R&D and gamma industrial irradiation services and a nuclear reactor, currently in conservation.

The institute is involved in numerous international collaborations in the field of nuclear physics. It is the main contributor to the Romanian participation to FAIR (GSI) and ISOLDE (CERN). The list of European projects were IFIN-HH was recently involved includes INDRANAP (FP5), HadronPhysics (FP6), EURONS (FP6) and EURISOL DS (FP6). In the field of nuclear data, IFIN-HH has shown the interest to become part of the Nuclear Structure and Decay Data (NSDD) Network coordinated by IAEA. Two nuclear data workshops were recently organized by IFIN-HH in collaboration with IAEA: DDEP-2008 and ENSDF-2009.

The scientists involved in the ANDES project have good experience in the field of nuclear data. Both A. Negret and C. Borcea worked previously at EC-JRC-IRMM contributing substantially to the neutron data measurements performed there during the last years. The main scientific interests of A. Negret include neutron inelastic scattering measurements but also nuclear structure and nuclear structure data evaluation. C. Borcea was involved also in the nToF project at CERN and is member of the NFS (Neutrons for Science) project developed around SPIRAL2 at GANIL-France. His scientific interests are neutron inelastic scattering measurements and, more generally, nuclear reaction experiments and the study of exotic nuclei far from stability. He has also a vast experience in detection systems and instrumentation. C. Borcea has also teaching and supervising duties at the Doctoral School of the University of Bucharest

Istituto Nazionale Fisica Nucleare (INFN)

The Istituto Nazionale Fisica Nucleare (INFN) is one of the largest public research agencies in Europe - with scientific, financial and accounting autonomy - dedicated to the study of the fundamental constituents of matter. INFN conducts theoretical and experimental research in the fields of subnuclear, nuclear, and Astroparticle Physics. Fundamental research in these areas requires the use of cutting-edge technologies and instrumentation, which INFN develops both in its own laboratories and in collaboration with the world of industry. Moreover, the INFN promotes the application of skills, methods, and experimental techniques developed in the course of its own research to other fields, such as medicine, artistic preservation, and environmental protection. Research activity at the INFN is carried out at two complementary types of facilities: the Divisions (Sezioni) and the National Laboratories. The Divisions are mostly located at University Physics departments, thus providing a direct connection between the Institute and the academic world. Today, INFN researchers make important contributions to research in various European laboratories, as well as in numerous research centers worldwide, often in the context of large International Collaborations. Within INFN, there exist a recognized expertise on studies of low-energy nuclear reactions, induced both by charged particles and neutron beams.

Key persons for ANDES:

Nicola Colonna is First Researchers of INFN at the Section of Bari. In his career, started in 1988, he has conducted research activities in the field of experimental Nuclear Physics, in particular in measurements of neutron-induced reactions. His fields of expertise include also neutron detectors and simulations of neutron transport. Since 2001 he has been leading the INFN team in the n_TOF project at CERN, dedicated to studies of neutron cross-sections for Astrophysics and Emerging Nuclear Technologies. He has participated to EC projects n-TOF-ND-ADS (FP V) and EUROTRANS (FP VI), and is currently involved in a Coordinated Research Project of IAEA (MANREAD, Minor Actinide Neutron Reaction Data). He is currently Financial Coordinator of the n_TOF Collaboration. He is co-author of more than 100 articles on refereed Journals, has presented numerous invited talks to International Conferences, and is tutor of several PhD theses.

Nuclear and Technological Institute (ITN)

The Nuclear and Technological Institute (ITN) is a State Laboratory reporting to the Ministry of Science Technology and Higher Education of Portugal, and its mission is to perform scientific research and technological development, particularly in the field of nuclear sciences and technologies, and the applications of radiations and radioisotopes.

ITN develops Research, Development and Advanced Training and Education activities in its fields of competence and provides important public service in the field radiological protection and safety.

In the framework of R&D activities in different areas, ITN operates unique specialised infrastructures that are made available to the outside scientific community, such as a research reactor, electrostatic accelerators (Van de Graaff and tandem), ion implanter, low temperature and high magnetic fields facilities, laboratories for handling radioisotopes, radiocarbon and luminescence dating, mass spectrometry, radiation metrology, among many others. As a consequence of its specialised and unique expertise ITN is a regular partner in national and international research networks and projects, with significant impact on materials, health, life and environmental sciences.

ITN group is involved in the n_TOF collaboration since 2001 and was involved in the CANDIDE project (Isabel Ferro Gonçalves and Pedro Vaz). Several Ph. D. students and Master Theses studants are/have been envolved in these activities.

Joint Research Centre, Institute for Reference Materials and Measurements (JRC-IRMM)

The Reference Laboratory for Neutron Physics, operated by the Neutron Physics Unit of the Joint Research Centre's Institute for Reference Materials and Measurements, is one of the key European laboratories for neutron cross-section measurements. It offers a combination of world-class neutron installations, experiments using state-of-the-art detectors and electronics equipment and co-operation with theoretical physicists for modeling of nuclear reactions. These activities are supported as a direct action of the EURATOM program. The measurements are performed at two facilities:

The Geel Electron Linear Accelerator GELINA is a white neutron source, where the time-of-flight (TOF) method is used to determine the energy of the interacting neutrons in the energy range from 1 meV – 20 MeV.GELINA is the pulsed white spectrum neutron source with the best time resolution. Together with flight paths ranging from 10 to 400m excellent neutron energy resolution is obtained. The facility runs on a 24-hours/day basis, for about 100 hours per week.

At the Van de Graaff (VdG) facility of IRMM quasi mono-energetic beams of neutrons are produced in the energy range up to 24 MeV. The Van de Graaff facility is a 7 MV electrostatic accelerator for the production of continuous and pulsed proton-, deuteron- and helium ion beams. The energy of the mono-energetic neutrons is defined by using lithium, deuterium or tritium targets and choosing appropriate emission angles. Depending on the neutron energy up to 10^8 neutrons/s can be obtained.

JRC-IRMM has dedicated equipment and expertise in the domain of measurements of neutron-induced reactions that cover the total, fission, capture and inelastic scattering processes of interest to this project. JRC-IRMM is an active participant to European projects with a nuclear data component and has ample experience with coordination of projects, work packages and tasks. JRC-IRMM actively collaborates in nuclear data projects operated by the OECD Nuclear Energy Agency and the IAEA Nuclear Data Section and has bilateral collaboration agreements with institutes in Europe, DOE and AECL.

Arjan Plompen is leader of the action “Nuclear data for waste minimization and safety of new reactor developments”. He coordinated work package 2 of the nuclear data for transmutation (NUDATRA) domain of the integrated project EUROTRANS, and is coordinator for a Joint Research Activity in the EFNUDAT integrated infrastructure initiative. He is coordinator of the NEA/OECD High Priority Request List for Nuclear Data and participated in the NEA/OECD subgroup 26 on "Uncertainty and Target Accuracy Assessment for Innovative Systems Using Recent Covariance Data Evaluations". He will coordinate the activities of ANDES WP1 and subtask 1.1.b. He and his team have ample experience in (n,n'γ)-measurements to determine inelastic scattering cross sections. Experience in the domain was demonstrated for ^{52}Cr, on ^{206,207,208}Pb and on ^{209}Bi by several publications and conference contributions.

Franz-Josef Hambsch is leader of the action “Basic research in nuclear physics and nuclear data standards”. He is scientific coordinator of the integrated infrastructure initiative “European facilities for nuclear data measurements (EFNUDAT)”. His scientific interests concern studies and modeling of the fission process. He and his team have extensive experience in neutron-induced fission studies. Notable examples of accurate cross section measurements in the MeV range concern the reactions ^{233}Pa(n,f) and ^{231}Pa(n,f). He will be responsible for subtask 1.3.b.

Peter Schillebeeckx is leader of the resonance range measurements and data analysis at the GELINA facility. His scientific interests include capture and total cross section measurements and the use of neutron resonance analysis for non-intrusive elemental composition determinations. He and his team have actively explored the limits of accuracy in capture cross section measurements in the resonance range. A notable achievement is the better than 2% uncertainty for the measured capture cross section of ^{232}Th in the unresolved resonance range. He will be responsible for subtask 1.2.a.

Jožef Stefan Institute (JSI)

The Jožef Stefan Institute is the leading Slovenian research organisation. It is responsible for a broad spectrum of basic and applied research in the fields of natural sciences and technology. The staff of around 800 specializes in research in physics, chemistry and biochemistry, electronics and information science, nuclear technology, energy utilization and environmental science. The main part of the institute is located in Ljubljana. The institute operates a TRIGA research reactor, which is located about three kilometres outside the town. The main research areas of the Reactor Physics Department are theoretical, experimental and applied reactor physics, plasma physics, nuclear fragmentation, neutron dosimetry, neutron radiography, the physics of semiconducting devices and oncology. The department provides services to the Krško Nuclear Power Plant such as nuclear core design verification, physics start-up tests, etc. The staff of the Department has expertise in neutron transport calculations using deterministic and Monte Carlo methods, benchmarking, nuclear data evaluation and processing for applications, sensitivity and uncertainty calculations, applied to criticality as well as shielding problems and fusion applications.

Andrej Trkov is a senior research associate at the Reactor Physics Department. He spent most of his career at the JSI, except six years (2000 – 2006), when he held the position of a Deputy Section Head of the Nuclear Data Section at the International Atomic Energy Agency. He is the main author of the CORD-2 package for nuclear core design calculations and made many contributions to the improvements and extensions of the NJOY Nuclear Data Processing System. He coordinated or assisted in several IAEA projects that resulted in application nuclear data libraries for transport codes. He is one of the developers of the EMPIRE-II system for nuclear data evaluation. He coordinated the project of the IAEA on Evaluated Nuclear Data for the Th-U Fuel Cycle, which resulted in ^{232}Th and ^{231,233}Pa evaluations (including covariances) that were adopted for ENDF/B-VII. He coordinated activities to deliver evaluated nuclear data files for the tungsten isotopes for a project within the Fusion for Energy Programme. His expertise also includes nuclear data verification and validation through modelling of benchmark experiments.

Ivan Aleksander Kodeli is a senior research associate at the Reactor Physics Department. He started his career at the JSI. He worked also as IAEA representative at the OECD/NEA Data bank (for two and seven years) and at CEA - Saclay for seven years. Recently he returned to the JSI. His expertise covers neutron transport calculations using deterministic and Monte Carlo methods. His specialties are sensitivity and uncertainty calculations, in particular for fission and fusion reactors, with some medical and industrial applications. He developed the SUSD3D cross section sensitivity/uncertainty code and several utility programs for the covariance matrix processing and verification, all available from the NEA-DB. He was in charge of the compilation of the shielding benchmark experiments for the SINBAD project of the OECD/NEA Data Bank and contributed to the IRPhE, UAM and other NEA projects.

The team at the Reactor Physics Department assigned to the proposed project also includes Igor Lengar (research associate), Luka Snoj (a post-doctoral fellow), Alberto Milocco (Ph.D. student), Gasper Žerovnik (Ph.D. student), Bojan Žefran and Slavko Slavic.

Accellerator Laboratory of the University of Jyväskylä (JYU)

University of Jyväskylä (JYU) is a public university receiving its basic funding from the Finnish Ministry of Education. With 16000 students and personnel of 2600 it ranks among the five largest universities in Finland. Department of Physics (JYFL) is the second largest department of the university. The experiments would be carried out at the Accelerator Laboratory, which is operated as a part of the Department of Physics. It has a national status in Finland as an expertise center in the field of accelerators and ionisating radiation. Accelerator Laboratory is also acknowledged as the Centre of Excellence of Academy of Finland since 2000. Accelerator Laboratory has shown interest to join the European Nuclear Structure and Decay Data Network of Evaluators (ENSS).

The research group involved in the project consists currently of 6 senior researchers and 8 graduate students. The research program consists of studies of nuclei far from the valley of beta stability and applications in astrophysics and weak interaction physics. It is carried out at the Ion Guide Isotope Separator On-Line (IGISOL) facility. Almost 30 peer reviewed publications, including numerous Phys. Rev. Letters are published annually.

The experimental program will use both the existing K = 130 MeV and a new high intensity K = 30 MeV cyclotron, expected to become operational during 2010. Half of the beam time of the K = 30 MeV cyclotron will be devoted for research at the IGISOL, increasing the amount of available beam time for fission product research significantly. IGISOL will be used to provide radioactive ion beams of fission products that will be injected into the high mass resolving power Penning trap, called JYFLTRAP. This device can be used as a high mass resolving power separator to produce monoisotopic sources for beta- and neutron spectroscopy. A total absorption spectrometer for measurements of beta strength function and a neutron long-counter detector for determination of beta delayed neutron emission probability are available.

JYFLTRAP also makes possible the measurement of independent fission product yields as well as precision mass measurements with a relative accuracy of better than 10^{-7}, corresponding to a relative precision of better than 10^{-3} in decay energy. It should be noted here that this equipment is currently unique worldwide both for its precision and high sensitivity for all radioactive nuclides.

The key persons involved in the project are:

Dr Heikki Penttilä: 20 years of experience of mass separation and nuclear spectroscopy of fission products. He is the experimental physicist responsible of the development of the mass separator and ion guides.

Prof. Juha Äystö: 30 years of experience: Experiments with atomic physics techniques, ion beam methods in relation to nuclear spectroscopy in nuclear physics, fission, nuclear astrophysics and weak interaction physics.

Dr. Ari Jokinen: 15 years of experience: Experimental methods in radioactive and stable ion beam science.

Dr. Tommi Eronen: 5 years of experience of research with Penning traps, in particular mass measurements and extreme high resolution ion beam purification.

In addition, we are aiming to hire a post-doc level researcher for the project. The younger members of the research group will participate in the project as well.

National Nuclear Laboratory (NNL)

The National Nuclear Laboratory (NNL) brings together a world-class nuclear research staff and facilities. The NNL is a unique resource constituting the bulk of the UK's remaining national nuclear research capability and all of the civil nuclear research facilities. The company comprises approximately 650 highly qualified staff based at six locations around the United Kingdom, operates both active and non-active research facilities and provides specialist technical and consulting services to a range of UK and overseas customers including the Nuclear Decommissioning Authority, MoD, UKAEA, British Energy, Magnox Electric Ltd, Sellafield Ltd and other commercial organisations.

The mission of the NNL includes the following:

- To be an international centre of excellence in nuclear research and development, playing a vital role in cleaning up the UK's nuclear waste legacy and contributing to the programme of nuclear new build.
- To create a platform for UK and internationally funded R&D

- To safeguard the UK's high-tech nuclear expertise, facilities and skills.
- To support the UK's strategic nuclear research and development requirements
- To operate world class facilities that underpin nuclear research undertaken by UK and international customers
- To safeguard and enhance key skills that are essential to deliver the UK's nuclear policy
- To deliver value for customers through the provision of first class science-based research and technical solutions
- To spin out commercial operations to assist in the development of the market for the provision of nuclear research

Robert Mills is a technical specialist with 21 years experience in the area of nuclear data and reactor modelling underpinning inventory code development. During this time he has supported planning and operation of UK reprocessing plants and contributed evaluations, nuclear data files and validation to the JEFF (Joint Evaluated Fission and Fusion file) nuclear data project of the OECD/NEA. This includes producing the fission yield data for the JEF-2.2 and JEFF-3 files. He is currently chair of the JEFF sub-group on decay data and fission yields. He held short-term contract research positions within the University of Birmingham and the Nuclear Energy Agency before joining BNFL in 1993. He has contributed to two collaborative research programmes of the IAEA on fission product yields, WPEC subgroups on decay heat and the EURATOM Framework projects RED-IMPACT and CANDIDE. He is the lead author on nuclear data papers ranging from evaluation, processing, application and validation; including 20 papers published in journals and conference proceedings, 77 papers to UK and JEFF committees and 32 internal laboratory reports.

Colin Zimmerman is a technical specialist with 33 years experience in applied nuclear physics. He joined BNFL in 1981 after five years of post doctoral research in the Nuclear Physics Group of the University of Edinburgh. He has worked on the design and installation of gamma and neutron measurement instruments on operating plant at the Sellafield reprocessing plant and for the last 20 years been a leading member of a team involved with reactor physics and radiation transport calculations supporting Sellafield operations. Recently he has managed the BNFL partitioning and transmutation (P&T) project, been a member of the OECD/NEA Working Party on the Science of the Fuel Cycle and the Expert Group on the Impact of Advanced Nuclear Fuel Cycle Options on Waste Management Policies, and been a partner in and work package leader of the 6th Framework RED-IMPACT project ('Impact of Partitioning, Transmutation and Waste Reduction Technologies on Final Nuclear Waste Disposal'). He is the lead author on a wide range of applied nuclear science papers including 34 papers published in journals and conference proceedings and 55 internal laboratory reports.

Nuclear Research and consultancy Group (NRG)

The Nuclear Research and consultancy Group, NRG, is an internationally operating company with a staff of more than 320, of which 65 % have an academic background, based on sites in Petten and Arnhem, the Netherlands. NRG performs independent research and provides expertise and services in support of the safe, ecological and peaceful use of nuclear installations and develops and applies spin-off technology for the non-nuclear markets. NRG participates in technology development programs for advanced nuclear power reactors design and fuels. The neutronics of reactor systems is a key research area in NRG, with emphasis on Monte Carlo transport and nuclear data. NRG is involved in many European projects, both as coordinator and as participant. NRG has a long experience in the field of computational simulation of nuclear processes. This ranges from basic nuclear reaction physics, the evaluation of nuclear data libraries, to sophisticated 3-D modeling of reactor systems with Monte Carlo.

Arjan Koning is program manager at NRG. He coordinates general nuclear research at NRG and is specialized in nuclear data for innovative reactor systems, transmutation of radioactive waste, fusion and various industrial applications. He is chairman of the JEFF (Joint Evaluated Fission and Fusion file) nuclear data project of the OECD/NEA. He has been chairman of the NEA Working Party on Evaluation Coordination (WPEC), which oversees all nuclear data file projects in the world, and one of the Dutch members of the NEA Nuclear Science Committee. His international working experience includes positions at CEA, France and Los Alamos National Laboratory, USA. On the technical level, he is specialized in theoretical and computational nuclear reaction simulation, for energies ranging from the unresolved resonance range up to several hundreds of MeV, and nuclear data library evaluation and validation for fission and fusion reactors and non-energy applications. He is (co-)author of about 200 publications ranging from basic nuclear reactions to applied nuclear science.

Dimitri Rochman is consultant at NRG. He is specialized in nuclear data evaluation and validation in the same area as mentioned above. His international working experience includes positions at ILL and CEA, France and Los Alamos National Laboratory and Brookhaven National Laboratory, USA.

Paul Scherrer Institute (PSI)

The Paul Scherrer Institute (PSI) is a multi-disciplinary research centre for natural sciences and technology. In national and international collaborations with universities, other research institutes and industry, PSI is active in solid state physics, materials sciences, elementary particle physics, life sciences, nuclear and non-nuclear energy research, and energy-related ecology.

Being a world-leading scientific institute, PSI is well-equipped with all nuclear physics and chemistry related instrumentations. As the most essential point, PSI operates the most powerful proton accelerator in Europe and, in addition the spallation neutron source SINQ, a facility, which is unique world-wide at the moment. Additionally, due to the work carried out in tight connection with the Swiss nuclear power plants, up-to-date Hotcell technique is available including in-cell equipment for the preparation and handling of highly active samples, cutting-edge analytical tools for their analysis and the corresponding highly-skilled personnel. Also, a wide range of radiochemical measuring techniques are available. As a particular advantage counts the first successful operation of a high-power liquid metal target (MEGAPIE), which gives PSI a unique experience and a head start concerning this technology on international level.

The working group RadWasteAnalytics under the leadership of Dr. Dorothea Schumann (Laboratory of Environmental and Radiochemistry) is experienced in the determination of radionuclides in accelerator waste, with a special expertise concerning the determination of long-lived isotopes from irradiated target materials. The group contributed to the HINDAS project (High and Intermediate energy Nuclear Data for Accelerator driven Systems) with several determinations of excitation functions of long-lived radio nuclides produced by proton irradiation of natural lead, and is involved in two integrated projects of the 6th frame work of the European Community (NUDATRA in EUROTRANS and EURISOL) as well as the recently started GETMAT project.

Studiecentrum voor Kernenergie – Centre d'étude de l'énergie nucléaire (SCK•CEN), Belgium

The Belgian Nuclear Research Centre (SCK•CEN) is a Foundation of Public Utility (FPU), with a legal status according to private law, under the tutorial of the Belgian Federal Minister in charge of energy. SCK•CEN has about 600 employees, of which one third has an academic degree. The statutory mission gives the priority to research on problems of societal concern: safety of nuclear installations, radiation protection, safe treatment and disposal of radioactive waste, fight against uncontrolled proliferation of fissile materials and fight against terrorism.

Since 1998 SCK CEN is developing in collaboration with IBA s.a. and many other European laboratories and research centres MYRRHA, an Accelerator Driven sub-critical System (ADS). It consists of a proton accelerator proton coupled to a liquid Pb-Bi spallation target in a Pb-Bi cooled and a sub-critical fast core. MYRRHA will serve as a basis for the European experimental ADS. It will provide protons and neutrons for various R&D applications, among others transmutation studies.

SCK CEN has participated in the European TWG on European Roadmap for ADS transmutation and coordinated the ADOPT Thematic Network. SCK CEN has participated in the following FP5 P&T projects: PDS-XADS, FUTURE, SPIRE, TECLA, MEGAPIE-Test, ASCHLIM, MUSE, and coordinates today the domain DM1 of the FP6 EUROTRANS Project. SCK•CEN is involved in the SNE-TP SRA and IAEA INPRO activities. SCK•CEN can offer integral validation measurements for nuclear data with the zero power facility VENUS.

Prof. dr. Hamid Aït Abderrahim, is the Director of the Institute of Advanced Nuclear Systems (+/- 100 persons). He is the MYRRHA project leader since 1998. He has a Nuclear Engineering degree and a Reactor Physics Ph.D. He participated in many FP5 projects related to P&T and ADS development such as PDS-XADS, ADOPT, FUTURE, ASCHLIM, MUSE, SPIRE, TECLA, MEGAPIE-Test.

Dr. Anatoly Kochetkov, educated in Moscow Physics and Engineering Institute (1980, Diploma of NPP Engineer). He holds a Ph.D from the Institute for Physics and Power Engineering (IPPE, Obninsk,1990). He was Head of the Laboratory, Head of experimental programs at BFS critical assemblies from 1980 till 2008. His main activities are the measurements and the analysis of the integral nuclear data of the main reactor materials on critical assemblies. He is responsible for the GUINEVERE experimental program at VENUS-F.

Technische Universitaet Wien (TUW)

The Vienna University of Technology (TU Wien) is the largest university in Austria for engineering sciences. It is a public university with about 18.750 students, funded by the Austrian Federal Government. It is organized in 8 faculties: Architecture, Civil Engineering, Technical Chemistry, Electrical Engineering and Information Technologies, Informatics, Mechanical Engineering, Mathematics, Physics. The Vienna University of Technology is involved in many international and national research projects focussed on different topics related to the expertise of each faculty. The TU Wien has experience in co-ordinating EC-projects.

The participating organization unit is the Atominstitut. The Atominstitut is part of the Faculty of Physics of the TU Wien. Currently 25 university positions for scientific personnel, 29 for non-scientific personnel and about 50 doctoral and diploma students are working at the Atominstitut. The research and training possibilities are grouped around a 250 kW TRIGA research reactor and include x-ray and accelerator installations, low temperature and quantum optic equipment and highly specialized chemistry and physics laboratories. The institute is participating in a doctorial college program and has a permanently occupied foreign post at the Institute Laue-Langevin (ILL) in Grenoble. The broad spectrum of research fields represented at the Atominstitut provides a fertile environment for productive scientific collaboration. A strong ‘bottom-up’ structure has guaranteed a development towards innovative areas of research. In particular there is internationally recognized expertise in the field of Nuclear Physics both in theory and experiment. The research groups at the Atominstitut are well integrated in the international research. Especially, they have successfully participated in several EC and EURATOM contracts, in some of them serving as coordinator. Apart from participation in European and national projects the members are actively involved in various activities of international organizations, e.g. in the International Nuclear Data Centres (NEA/OECD and IAEA).

The responsible person involved in the scientific part of the project is:

Ao. Univ. Prof. Dr. *Helmut Leeb* (1952), Associate Professor at the Atominstitut, TU Wien since 1986; specialised in Theoretical Nuclear Physics. The scientific activities are focussed on scattering and reaction theory and its application to nuclear and neutron physics; more than 150 scientific articles on nuclear and neutron physics in international journals. More than 250 talks at universities, research institutes and conferences. Vice Dean of Academic Studies in “Physics” of the TU Wien, member of the Subcommittee 3 “Nuclear and Particle Physics” of the ILL Scientific Council, member of the Isolde and Neutron Time-of-Flight Experiments Committee (INTC) at CERN, Austrian delegate in the Nuclear Science Committee of NEA/OECD. Leader of several research projects supported by Austrian funding agencies and participant in several EC-projects, in particular coordinator of the Network PANSI3 within EURONS, participant in 3 EFDA projects and IP_EUROTRANS on nuclear data and team leader of the Austrian team in the EC-project nTOF-ND-ADS.

Ms. Denise Neudecker will be involved as PhD student.

University of Bucharest (UB)

The University of Bucharest is one of the leading institutions of higher education in Romania, and enjoys a considerable national and international prestige. Its various schools are well known for their activities in all important scientific and academic domains. There are over 50 institutes, departments and research centres functioning within UB, most of which work in collaboration with similar centres in other countries.

The Faculty of Physics was founded in 1967 as an independent branch of the Faculty of Mathematics and Physics of the University of Bucharest, one century and a half old center of traditions in basic and technical science, teaching and research.

The Department of Atomic and Nuclear Physics gives Master and PhD degree in: atomic and molecular interactions, astrophysics, nuclear interactions, elementary particles, and applied nuclear physics. The teaching staff is recognised internationally for their research activities, and collaborations with prestigious institutions in the field (NEA DB Paris, IAEA Vienna, IRMM Geel, PTB Braunschweig, LNHB Saclay, BNL, CERN, GSI, etc.)

Mihaela Sin is associate professor at the Department of Atomic and Nuclear Physics, Faculty of Physics, specialized in nuclear reaction models including fission. She is member of the developers' team of the nuclear reaction code EMPIRE. Most of her activities in the nuclear data field have been carried on in collaboration with the Nuclear Data Section of IAEA. She participated at two coordinated projects: Evaluated Nuclear Data for the Th-U Fuel Cycle (contributing in ^{232}Th and ^{231,233}Pa evaluations that were adopted for ENDF/B VII) and Minor Actinides Nuclear Reactions Data. She was also involved in support activities for other two CRPs: Nuclear Data for Production of Therapeutic Radionuclides (by evaluating the production cross sections of a significant number of radionuclides) and Parameters for Calculation of Nuclear Reactions of Relevance to Non-energy Nuclear Applications RIPL-3 (by testing on actinides optical model parameters, level densities and fission barriers).

University of Liège ULG

The University of Liège (ULG) is the only complete public University of the French-speaking part of Belgium. It is financed, for the largest part, by the local government.

The missions of the ULG are threefold: teaching, research and support to the Region.

ULG has eight faculties including Science and Engineering.

Research at ULG is run by the departments.

Concerning nuclear sciences, ULG has developed expertise in thermohydraulics of nuclear reactors and has a high level program in theoretical nuclear physics, in particular in spallation and transmutation.

ULG has an agreement with the SCK-CEN, Mol, Belgium, for a collaboration in the ENEN teaching program and for exchanges of researchers.

Universidad Politécnica de Madrid (UPM)

Universidad Politécnica de Madrid (UPM) is the oldest and largest Spanish technical university, with more than 3.000 faculty members, around 38.000 undergraduate students and 6.000 postgraduates in 21 Schools of study. UPM's Schools cover most of engineering disciplines, including Aeronautical, Agronomical, Chemical, Civil, Electrical, Electronic, Forestry, Industrial, Mechanical, Mining, Nuclear, and Naval Engineering, as well as Architecture, Computer Science and Geodesy & Cartography. UPM, as a top quality academic establishment, has a strong commitment to R&D and Innovation. It boasts over 200 Research Units and several Research Institutes and Technological Centres, which cover various scientific disciplines such as Architecture, Solar Energy, Nuclear Fusion, Automotive Security, Microgravity, Opto-electronics and Micro-electronics, Domotics, Laser Technology, Biotechnology and Genomics of Plants, Industrial Electronics, Advanced Materials, and Software.

Madrid Polytechnical University (UPM) embodies several colleges, including ETSII (Industrial Engineering College) where the Nuclear Engineering Department and the Institute on Nuclear Fusion are placed. The UPM gives Master degrees on Power Engineering and Nuclear Engineering, as well as PhD degrees.

This group has a wide expertise in the area of fusion for more than 10 years on the issues of neutronics, activation of materials and Safety & Environmental (S&E) assessments. This group has developed an inventory/activation computer code, named ACAB. Some of the singular capabilities of the ACAB code, such as i) compute uncertainties on activation/isotopic inventory calculations due to cross section uncertainties, and ii) deal with practically arbitrary irradiation and cooling operational regimes; has attracted the interest of other communities for the ACAB code. This is the case of its application to the Accelerator Driven System (ADS) transmuters. We have been working in this field for the last 5 years, and relevant contributions have been done in evaluating the impact of activation cross section uncertainties on the actinide composition of the irradiated fuel in representative ADS irradiation scenarios. We participate in the Integrated Project EUROTRANS (EUROpean Research Programme for the TRANSmutation) and we are leading the Work Package on Sensitivity-uncertainty Analysis and Nuclear Data for Transmutation included in the Domain 5 of the Project, called NUDATRA. We are also leading the collaboration with CIEMAT in order to get ready the system ACAB-MCNPX for the ADS design activities, which will replace the System ORIGEN-MCNPX that traditionally CIEMAT has been using. The new system has been successfully used very recently.

Oscar Cabellos is MSci power engineering in 1993 and PhD Nuclear Engineering in 1998, both from the Universidad Politécnica of Madrid (UPM). He is Associate Professor of nuclear engineering at the Department of Nuclear Engineering at the UPM. He entered at the Institute of Nuclear Fusion at UPM in 1998, and currently is member of the S&E research group. He has written nineteen papers in JCR-Journals, and more that 30 publications in Proceedings Books. He is the co-author of the computer code ACAB, extensively used by several institutions to predict the isotopic inventory in different kind of nuclear systems. He has participated in the EUROTRANS project updating ACAB code and performing an extensive work on uncertainty/covariance nuclear data for ADS.

Nuria García-Herranz is MSci in Power Engineering, 1995, and PhD in Nuclear Engineering, 2000, both at Universidad Politécnica de Madrid (UPM). She is Associate Professor at the Department of Nuclear Engineering at UPM. She has extensive experience in reactor physics and more recently, she has performed research activities in the transmutation field, participating in the EUROTRANS project.

Universidade de Santiago de Compostela (USC)

The University of Santiago de Compostela is a high education institution offering 63 official degrees and developing research activities in all areas of knowledge. In particular, the Nuclear and Particle Physics department has a long experience in basic research using the most outstanding European infrastructures in the field like CERN, GSI or GANIL. Scientists from USC have competences in the experimental and theoretical investigations on nuclear physics. In particular they have been highly involved in experiments at GSI and CERN n-TOF dealing with fission and neutron-induced reactions. They also have participated in several EC projects related to basic nuclear data for nuclear waste transmutation like HINDAS, n-TOF-ND-ADS or EUROTRANS.

Key persons for ANDES

Dr. José Benlliure, professor at the University of Santiago de Compostela, obtained his Ph.D. at the University of Valencia in 1995 with work on nuclear multi-fragmentation done at GANIL (France) from 1991 till 1995. Postdoctoral positions at LPC-Caen (France) (1995) and GSI (Germany) (1996-1998). In 1998 he obtained and associated lectureship at the University of Santiago de Compostela and in 2002 a full lectureship in the same university. His main scientific activity deals with the investigation of nuclear reactions in particular fission, spallation and fragmentation. He is co-author of more than 120 publications has presented numerous invited talks in international conferences and has supervised six PhDs. Presently he is member of the Subcommittee 3 “Nuclear and Particle Physics” of the ILL Scientific Council, the GANIL Scientific Council and the FAIR Scientific and Technical Issues Committee.

Uppsala University (UU)

Uppsala University is one of the leading universities in the Nordic countries and is ranked among the top 100 universities in the world. The Faculty of Sciences and Technology alone has about 1600 employees and 8700 students, and has an annual turnover of about 140M€. The Svedberg Laboratory of Uppsala University with its unique 20-180 MeV quasi-monoenergetic neutron beam has over the years served as experimental facility for a series of experiments relevant for the development of advanced reactor systems. The nuclear reactions group has a long standing experience in measuring data on neutron induced reactions at both TSL and other facilities and is currently or has previously participated in FP5 (HINDAS) and FP6 (EFNUDAT, CANDIDE and EUROTRANS). The group is furthermore part of the Generation-IV Industry-University Swedish consortium (GENIUS). In addition to the data measurement activities, the group has a strong activity in teaching reactor physics and close related subjects to industry employees.

Personnel:

Stephan Pomp is associate professor in applied nuclear physics at the department of Physics and Astronomy and head of the nuclear reactions group. He is deputy coordinator of the EFNUDAT project and UU representative in the European Radiation Dosimetry Group (EURADOS). His main research activities are within neutron induced reactions at high energies. He has more than 90 publications in refereed journals and conference proceedings.

Michael Österlund is associate professor in applied nuclear physics at the department of Physics and Astronomy and head of the Division of applied nuclear physics. He has 69 refereed papers and conference contributions and is co-author of two physics text books.

Alexander Prokofiev is senior scientist and project leader and the primary contact person at the neutron and proton irradiation facilities of The Svedberg Laboratory. His research areas are production, detection and monitoring of high-energy neutrons, neutron standards and metrology, and application of neutron beams. His CV contains about 90 publications in international journals or presented at international conferences.

The team also includes Cecilia Gustavsson (senior researcher), Henrik Sjöstrand (senior reseracher), Anders Hjalmarsson (senior research engineer), Riccardo Bevilacqua (Ph.D. student), Pernilla Andersson (Ph.D. student) and Vasily Simutkin (Ph.D. student).

B 2.3. Consortium as a whole

The consortium has brought together a large fraction of the most advanced groups in all the steps of the nuclear data development cycle. It includes several groups recognized as expert in different techniques for differential measurements like JRC (responsible of the Gelina facility), CIEMAT (present spokesperson of the nTOF collaboration), CNRS responsible for the AIFIRA accelerator facility at CENBG, the Orsay tandem accelerator laboratory and the GANIL facilities, the JYU operating the Jyväskylä accelerator laboratory. The consortium also includes important groups of well reputed experience in development of measurement equipment and data analysis at CEA, INFN, ITN and others. It also includes experts on cross section evaluation, like CEA, TUW and NRG, the authors of the TALYS system. These same groups plus UPN and CIEMAT have been recently very active performing sensitivity analysis related to advanced systems and fuel cycles. CEA, SCK-CEN, CNRS and CIEMAT are responsible or largely involved in integral experiments and their utilization for benchmarking nuclear data and simulation tools and to obtain feedbacks on needs for improvements in specific reactions and energy ranges. CEA, USC and the UU are among the most advanced experimental teams for measurements at energies beyond 150 MeV. PSI has access to the best experimental data for spallation targets from MEGAPIE and SINQ, and GSI, CEA and ULG are the responsible institutions and authors of the INCL4 and ABLA high energy models. Most of the ANDES teams have been deeply involved in dissemination, education and training activities related to nuclear data in the last years. A good fraction of the associated institutions are involved in the development of new reactor concepts and their associated technologies with the aim of improving the present and future sustainability of nuclear energies.

In addition, many members are deeply involved in international organizations and expert groups related to nuclear data and its utilization. Particularly important are the NEA groups (WPEC, WPFC, IRPhE,…), IAEA expert groups and CRPs, the SNETP and its SRA, and the other FP7 projects on advanced nuclear systems.

Altogether this constellation of teams is very well prepared to identify and prioritize the nuclear data needs, to evaluate the feasibility and best methods to perform the required measurement, to evaluate and afterwards assessing all the attached uncertainties and covariances, and to validate and disseminate the final results. Some further details are given below for individual work packages.

For each of the tasks of WP1 "Measurements for advanced reactor systems", teams with established experience and complementary specializations are brought together. For task 1.1 on measurements of inelastic scattering CNRS/IPHC operates a setup dedicated to (n,xnγ) measurements for actinides at the GELINA facility while JRC-IRMM operates the GAINS setup at a 200m station of the same facility. IFIN-HH has experience in inelastic scattering measurements gained from close collaborations with both the JRC and the CNRS group over the past eight years and is therefore well placed to carry out the assigned tasks.

For task 1.2 on measurements for capture cross sections, the team at JRC-IRMM operates three setups at the GELINA facility. On the other hand, CEA, CIEMAT, INFN, ITN and co-workers have developed two setups for capture measurements at the n_TOF facility in the context of the N_TOF-ND-ADS FP5 project. Interactions between the teams of GELINA and n_TOF will be essential for achieving the very low uncertainties required for ^{238}U capture and for ^{241}Am capture. The success of this concept of different teams working on the same reactions was demonstrated for ^{232}Th for which in the end a final uncertainty of better than 2% could be claimed for the individual measurements in the energy range above 1 keV. The experience of the team lead by CNRS/CENBG working with surrogate neutrons is now well established and unique in Europe. Their exploratory efforts for ^{233}Pa to apply the technique to capture reactions look promising and through CEA/DAM established top-level expertise in modeling of reactions on actinide targets is guaranteed.

For task 1.3 on measurements for fission cross sections, the team working with surrogate neutrons described above has gained a large experience in previous fission measurements of minor actinides (^{233}Pa, ^{243}Am, ^{242}Cm, ^{243}Cm and ^{244}Cm). For ^{240}Pu and ^{242}Pu, fission cross sections measurements three setups are foreseen to address the difficult problem of reaching percent level uncertainties. The teams involved, CNRS/CENBG, JRC-IRMM, INFN, ITN, have demonstrated experience with advanced techniques for fission cross section measurements that was gained in the recent past (5-10 years). For the team involving measurements of fission yields for fission of Np, Pu and Cm, their expertise follows from recent test measurements at GANIL. For task 1.4 on decay data measurements the Jyvaskyla team operates leading equipment in Europe and has a well established reputation in nuclear spectroscopy and spectrometry.

WP2 has participants that cover the entire nuclear data evaluation process from front-end to back end. TUW, UB, NRG and CEA-DAM are well known for the development of covariance data and/or its connection with the associated basic physics processes. Next, there are various partners (UPM, CEA-DEN, CIEMAT, NRG, NNL) who are well equipped to produce nuclear data libraries and apply them in reactor/fuel cycle software, including uncertainty propagation. While nuclear data libraries are end points for ANDES, they are starting points for nuclear industry. Indeed, most industrial contacts of CANDIDE are present in WP2 and WP3.

To reach the goal that is foreseen in WP3, different expertises are need: nuclear data and reactor physicists, experimentalist in critical facilities such as VENUS and MASURCA and code developers. The collaboration in this WP of CEA, NRG, JSI, CNRS, SCK-CEN and CIEMAT will put together all this knowledge. CEA has a good knowledge of the sensitivity analysis together with CNRS, JSI and CIEMAT. All the participants are specialists of Monte Carlo simulation to analyze the critical experiments. Most of them are also experts in deterministic simulation. Finally, CEA, SCK-CEN, and CIEMAT bring the knowledge on the experiments that are used. The cross analysis by these specialists will ensure that the conclusions will be focused on nuclear data feedback and not due to code modeling or experimental uncertainties.

WP4 will bring together the best specialists of high-energy reactions in Europe. The collaboration between experimentalists (USC, PSI, CEA/DSM, CNRS, UU) and theoreticians (ULG, GSI, CEA/DAM, NRG) will guaranty that the models are compared with well chosen experimental data, taking into account possible experimental biases. The involvement of specialists of simulation codes (CEA/DSM, NRG) will ensure that the work will be focused on improvements having an impact on key parameters of ADS demonstration facility. For the experiments, laboratories providing the accelerator facility (GSI, UU, PSI) will collaborate with partners (CEA/DSM, USC, CNRS) bringing essential parts of the detection setup.

No subcontracts or partners from outside the EU or future additional partners are foreseen.

B 2.3.1. Third parties.

CNRS will participate in the workpackages WP1, WP2 and WP4. For the WP4, CNRS will participate in collaboration with the UNIVERSITE CAEN Basse Normandie through their Joint Research Unit (JRU) of LPC Caen.

The beneficiary, CNRS, wishes to represent the UNIVERSITE CAEN Basse Normandie. So CNRS needs to insert clause 10 to the Grant Agreement, allowing them to show the participation of this other member of the JRU. This Special Clause 10 is included in paragraph B.2.3.2.

B 2.3.2. Special Clause 10 for CNRS

Project Number		Project Acronym	ANDES	Participant number	
Participating organisation					
Organisation legal name	**CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE**				
Organisation short name	**CNRS**				

Clause 10: text

THIRD PARTIES LINKED TO A BENEFICIARY [for the Joint Research Unit LPC Caen (UMR 6534)]

The following special conditions apply to this contract:

1. The following third party is linked to CNRS:

- **UNIVERSITE CAEN Basse Normandie**

2. This *beneficiary* may charge costs incurred by the above-mentioned third parties in carrying out the *project*, in accordance with the provisions of the *grant agreement*. These contributions shall not be considered as receipts of the *project*.

The third party shall identify the costs to the *project* mutatis mutandis in accordance with the provisions of part B of Annex II of the *grant agreement*. Each third party shall charge its eligible costs in accordance with the principles established in Articles II.14 and II.15. The *beneficiary* shall provide to the *Commission*:

- an individual financial statement from each third party in the format specified in Form C. These costs shall not be included in the *beneficiary*'s Form C
- certificates on the financial statements and/or on the methodology from each third party in accordance with the relevant provisions of this *grant agreement*.
- a summary financial report consolidating the sum of the eligible costs borne by the third parties and the *beneficiary*, as stated in their individual financial statements, shall be appended to the *beneficiary*'s Form C.

When submitting reports referred to in Article II.4, the *consortium* shall identify work performed and resources deployed by each third party linking it to the corresponding *beneficiary*.

3. The eligibility of the third parties' costs charged by the *beneficiary* is subject to controls and audits of the third parties, in accordance with Articles II.22 and 23.

4. The *beneficiary* shall retain sole responsibility towards the *Community* and the other beneficiaries for the third parties linked to it. The *beneficiary* shall ensure that the third parties abide by the provisions of the *grant agreement*.

B 2.4. Resources to be committed

The ANDES project is an imaginative project with the aim to produce high precision data with precisely evaluated uncertainties for the development future Advanced Fast systems (critical reactors or subcritical Accelerator Driven Systems) and waste minimization in closed fuel cycles using Partitioning and Transmutation technologies. The total effort corresponding to the financial statements of the A3 forms correspond to more than 670 persons*month over a period of 36 months.

However, beyond the resources declared in part A3, a sizeable amount of resources are made available by the consortium to the project. These resources refer to the access to experimental facilities, use of infrastructure, data, samples, and expertise for the operation of the experimental and computational tools. Some examples are:

- Access to experimental facilities for performing the new measurements:
  - IRMM neutron sources, both the electron linear and the Van de Graaff accelerators.
  - The n_TOF spallation facility at CERN
  - The Jÿvaskÿla cyclotron and the IGISOL facility.
  - The CNRS/Orsay accelerators.
  - The GANIL accelerator complex.
  - The GSI accelerator complex.
- Access to all the necessary infrastructure and instrumentation: n_TOF 4p total absorption calorimeter, arrays low neutron sensitivity C_6D_6 detectors, the GAINS ?-ray array and all the associated equipments and electronics.
- Basic skills to operate all the infrastructures and experimental facilities.
- Access to infrastructures as the hot-cells for analyzing the MEGAPIE and SINQ samples.
- All the samples, including the actinides, to be irradiated (irradiation costs are not charged) are made available for this project.
- Availability of supercomputing facilities, computational tools and expertise for the computational tools. Several participants are developers of state of art evaluation (TALYS), cross section analysis (CONRAD) and fuel cycle calculation (EVOLCODE+ACAB) codes and high energy spallation models (INCL4 and ABLA).
- Access to the detailed information and data of reference integral experiments MUSE, ZPPR10A, PROFIL, VENUS-F and irradiated samples and data from MEGAPIE and SINQ.

Furthermore most of the partners have internalized the travel costs to participate in the necessary meeting for the scientific and technological coordination of the different activities in the project and to a part of the travel and subsistence cost necessary to perform the experimental activities of the project. The coordination with the EC projects EUFRAT and EFNUDAT (and its continuation if any) will be maximized to get support for the access to these facilities.

The totality of the necessary resources including those that will complement the EC contributions, is distributed among the activities described previously in section II.3. These activities are subdivided in Work packages (section II.3.2) and tasks (section II.3.10) and the related effort for each task by each partner has been evaluated and allocated as indicated in the Table of requested EU contributions.

Included in this effort, financial resources have been allocated as well to the training activities and dissemination of results included in a specific work package (WP5). In this sense the A3 forms include for the Co-ordinator some personal cost to support the project management, training and dissemination and an allocation of 90kEuro to support the travel and subsistence of the End-Users group. CEA and NRG will also participate in the management activities and NRG and IRMM will participate in the coordination of the dissemination activities, including travels to insure the correct and efficient interface with the international agencies distributing nuclear data. The UU will co-ordinate the training activities and will get a small financial support to organize one specific nuclear data school. Small allocations of financial support have been, correspondingly, included in the “Management” and “Other” activities slots of the A3 forms.

The overall financial plan of the project is effectively defined in order to perform the foreseen experimental and computational activities to reach the declared objectives.

Activity Type	CIEMAT	CEA	CNRS	GSI	IFIN-HH	INFN	ITN	JRC	JSI	JYU	NNL	NRG	PSI	SCK-CEN	TUW	UB	ULG	UPM	USC	UU	TOTAL ACTIVITIES
RTD/Innovation activities																					
WP 1	120.0	125.0	205.0	0.0	70.0	120.0	40.0	269.92	0.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	1014.92
WP 2	40.0	120.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90.0	135.0	0.0	0.0	85.0	50.0	0.0	120.0	0.0	0.0	640.0
WP 3	80.0	170.0	50.0	0.0	0.0	0.0	0.0	0.0	75.0	0.0	0.0	75.0	0.0	75.0	0.0	0.0	0.0	0.0	0.0	0.0	525.0
WP 4	0.0	170.0	30.0	75.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	85.0	0.0	0.0	0.0	75.0	0.0	85.0	45.0	585.0
Total 'research'	**240.0**	**585.0**	**285.0**	**75.0**	**70.0**	**120.0**	**40.0**	**269.92**	**75.0**	**60.0**	**90.0**	**230.0**	**85.0**	**75.0**	**85.0**	**50.0**	**75.0**	**120.0**	**90.0**	**45.0**	**2764.92**
Demonstration activities																					
Total 'demonstration'																					
Consortium management activities																					
WP 6	31.0	7.5										10.0									48.50
Total ' management'	**31.0**	**7.5**										**10.0**									**48.50**
Other activities																					
WP 5	119.0	7.5						15.08				15.0								25.0	181.58
Total 'other'	**119.0**	**7.5**						**15.08**				**15.0**								**25.0**	**181.58**
TOTAL BENEFICIARIES	390.0	600.0	285.0	75.0	70.0	120.0	40.0	285.00	75.0	60.0	90.0	255.0	85.0	75.0	85.0	50.0	75.0	120.0	90.0	70.0	2995.00

Request from EC (kiloEuros) per activity type per beneficiary.

B 3. Potential impact

B 3.1. Strategic impact

The ANDES project has been designed to directly respond to the nuclear data needs, identified in the NEA/OECD and NUDATRA sensitivity analysis, for the reactors and fuel cycles proposed in the SRA of the SNETP to bring the nuclear generation of electricity to a higher degree of long term sustainability. The projected results should allow:

- improving the accuracy of the critical cross sections for the optimization and safety of the Gen III(+) LWR and Gen IV Fast Reactors (^{238}U reactions, fission cross sections and the inelastic in the coolant and structural materials) and consequently to improve their simulations reliability,
- improving the accuracy of the spent fuel composition predictions for the different advanced fuel cycles, including or not P&T and multi-recycling, and so improving the simulation of the decay heat, radioactivity and shielding requirements for the different fuel cycle facilities (^{241}Am cross sections), Further improvement of these final fuel cycles parameters will be gained by improving the nuclear data of the decay of relevant fission products,
- improving the reliability of the accuracy assessments of the advance reactor systems and fuel cycle simulations, by providing better uncertainties and covariance information, and tools to easy the rigorous and systematic preparation and use of this information in neutronic simulations,
- improving the validation and assessment of the final accuracy of the simulations by comparison with precise integral experiments selected for being good representation of the advanced reactor systems,
- improving the predictability of the performance, shielding and radioprotection parameters of intermediate energy spallation targets (150-600 MeV), by specific measurements in this energy range and additional validation and tuning of the high energy models to the available experimental results.
- All together these developments will improve the confidence on the selection of options along the roadmap towards more sustainable nuclear systems, whereas simultaneously allowing to optimize the utilization of the few available experimental reactors and present and future demonstration facilities.

Measurement results of WP1 and the experience gained in performing them will contribute significantly to the improvement of the values and the uncertainties of the nuclear data that are addressed. They will provide an excellent basis for improving evaluations for these nuclear data, both for the evaluated values and the associated covariances. In addition, the experimental efforts of WP1 will provide added experience on new methods and setups that will serve to understand how to tackle important remaining issues of nuclear data for advanced reactors.

The impact of WP1 for advanced reactors may be understood from the sensitivity studies performed by the NEA-OECD [4] as follows. Beginning of life, BOL, multiplication factors for fast reactor systems have an uncertainty between 1 and 2% for critical fast systems and about 3% for an Accelerator Driven Minor Actinide Burner (ADMAB), induced just by nuclear data uncertainties. Systems engineers require an uncertainty of 0.3% for this multiplication factor. The present uncertainty of 20% on the ^{238}U inelastic scattering cross section results in a contribution between 0.7 and 1.4% for advanced fast critical systems (ADMAB has no ^{238}U), so any substantial reduction in the ^{238}U inelastic cross section uncertainty has a major impact on the uncertainty of the multiplication factor. Other reactions studied in WP1 and with present uncertainties leading to substantial impact on the multiplication factor are ^{56}Fe inelastic scattering (current unc.20%, impact

0.2-0.9%), ^{23}Na inelastic (current unc.30%, 0.25%, SFR only), ^{238}U capture (impact 0.25-0.4%), and for the fission reactions of the present project the impacts are between 0.2 and 0.5% per reaction. So, aside from one or two larger contributors the large uncertainty for the multiplication factor results from the accumulation of a substantial number of smaller contributions. This justifies tackling reactions simultaneously.

Another important quantity is the void coefficient for which engineers require a target uncertainty of 7%. Currently, nuclear data result in larger uncertainties for the void coefficient for all concepts except the gas-cooled fast reactor. Primary causes for these are the nuclear data uncertainties for the ^{238}U, ^{56}Fe, ^{23}Na inelastic scattering cross sections, the ^{238}U capture cross section, and all of the fission cross sections studied in ANDES. Improvements for the ^{241}Am capture reaction (present uncertainty 10%, target uncertainty well bellow 5%) will benefit the uncertainty of the burnup reactivity swing estimates for gas-cooled fast reactors and ADMAB as well as estimated nuclide densities for ^{238}Pu, ^{241}Am, $^{242(m)}$Am, and ^{242}Cm. This conclusion is independently corroborated by the NUDATRA domain in IP EUROTRANS. Indeed, when the full fuel cycle is taken into account (instead of one independent reactor) the capture in ^{241}Am and ^{243}Am is strongly affecting the production of these isotopes and all the higher mass Cm, Bk and Cf isotopes. Zr inelastic scattering improvements will benefit peak power estimates whenever it is part of the (inert-) matrix of a fuel (gas-cooled fast reactors GFRs and ADMAB). So it is anticipated that WP1 efforts of ANDES will allow a substantial reduction of uncertainties in predictions for fast reactor systems regarding important problem areas: the multiplication factor and the void coefficient, as well as for peak power and nuclide density estimates. Finally, the fission yields and decay data measurements address important aspects of spent fuel handling and reactor kinetics. Although not explicitly prioritized by sensitivity studies, current day experience and efforts in EUROTRANS, OECD-NEA and CANDIDE working groups emphasize their importance for Gen III(+) and Gen IV systems.

The impact of WP2 will be on the side of the nuclear data users. All assets are present to work towards a nuclear data library of unprecedented quality to enable realistic design calculations for future sustainable nuclear reactors. Tighter constraints in safety-economy have led to calls for more and better nuclear data, especially covariance data. This will hold in particular for some of the designs foreseen in Europe, such as the ESFR and MYRRHA. The provision of such nuclear data is challenging, though feasible, but there is no single country in Europe that has all the aspects (experimental facility, nuclear model code, validation system) under control. Instead, a quality-assured nuclear data library for innovative nuclear systems can only be accomplished through a concerted effort from experimentalists, theorists, data evaluators and reactor physicists from across Europe. Indeed, one of the main assets of the ANDES project is the assembly of a combination of the most relevant nuclear data teams around Europe in all different aspects of the nuclear data, to respond to these challenges. Technological innovation has remained shielded too long from many important nuclear physics and computational developments. Europe has a few of the world-leading teams in nuclear data evaluation, and is thus well equipped to change this situation.

The WP3 impact had been optimized by selecting representative integral experiments for the advanced reactor systems involved in the SNETP roadmap towards sustainability. PROFIL measurements, made at special pins in the sodium cool fast experimental reactor PHENIX, provide information for fast reactors and advanced fuel cycles. MUSE and ZPPR10A experiments had been performed in the corresponding fast experimental reactors with simulated sodium cooling. The VENUS-F core of the GUINEVERE will be the best available experimental simulation of both a critical and an ADS cooled by lead. These integral experiments will be complemented by selected results from the large NEA/OECD compilations in the ICSBEP and IRPhE Handbooks.

The work of WP4 will provide high-energy models, implemented into transport codes, specifically improved and validated in the energy domain relevant for ADS demonstration facility design. This will allow reducing the safety margins on key parameters related to the radioprotection and material damage problems in the spallation target and surrounding structures. To achieve this project, the best European specialists of high-energy reactions, experimentalists, theoreticians and code developers, will collaborate in a coordinated and focused effort. The experimental program will be conducted at the most appropriate European accelerator facility (GSI) and use the most recent and efficient detection setups built within European collaborations.

All these effort could be lost or their impact delayed without an efficient dissemination strategy. For these reason WP5 includes specific actions to coordinate the transfer of this information and its distribution by the international organizations (NEA/OECD and IAEA) usually distributing the nuclear data libraries. WP5 also includes the creation of an End-Users group to make sure of their early awareness of the new results, and to get their feedbacks and advice to further focus and optimize the project activities to accelerate the impact of the new results in their final applications. Furthermore, the training activities in WP5 are oriented to maintain and transfer the know-how to new generations of researchers assuring the future continuation and development of this type of research.

B 3.2. Plan for the use and dissemination of foreground

The time between nuclear data developments, such as high-quality measurement and regular utilization has been often far too long in the past. This is a crucial issue, since those companies and institutions that can assure and reduce the cycle time for innovations and quality improvements in nuclear data have a distinct advantage in either research or industrial markets. This time interval was already reduced in the EUROTRANS-NUDATRA project by teams also participating in the ANDES project, and the lessons learn will be applied in this new project. Still, all possible means to accelerate the access and utilization of the new evaluated data, uncertainties and models are worth to make sure that they can contribute in the new designs of sustainable nuclear systems and in the associated technological choices. For these reasons, the project acknowledges the large importance of the dissemination, up to the point of dedicating a particular work package to this activity together with the training, education and the general project management.

The first step for dissemination is to distribute the nuclear data. This is done by their incorporation into one of the nuclear data bases distributed by international centers, particularly NEA/OECD or IAEA. Special links with the NEA/OECD and the IAEA will be established by members of the project who are also participating in the nuclear data expert groups of both institutions. These connections will facilitate the transfer of the results of the project to the international nuclear data libraries managed by the corresponding central distribution centers of the NEA/OECD and IAEA. This mechanism will also provide control to the access of the results.

The second factor for dissemination is bringing data close to the End-Users. In this sense a special action will gather an End-Users group with two types of participants: related nuclear data groups not participating directly in the project and industries and designers involved in the preparation of sustainable nuclear systems or fuel cycles. These End-Users will get early access to the results produced in the project and will be invited to participate in the general meetings to contribute to scientific and technical discussions. Their feedback and advice will be taken into account along the execution of the project. Special provision will be made within the project to provide financial support (travel costs and subsistence) to cover their participation in the general meetings. At least one general meeting per year will be organized with support for the participation of End-Users group members. More details are presented in WP5.

In addition, this project will continue the well established tradition of producing a large number of scientific publications and contributions to international conferences. NTOF_ND_ADS, HINDAS and more recently EUROTRANS-NUDATRA are clear examples of the high productivity of the FP5 and FP6 nuclear data projects in these types of indicators.

Finally the project will setup very early after start-up an internet web site to exchange information and documents, deliverables, presentation in the project meetings and news within the project partners. The web site will include three sections: one private only for the partners, a second one open to partners and the End-Users group and a third one for the general public, with general information and the final results of the project. The Executive Committee will promote the connection to this open web page by the project partners and End-Users.

Transfer of the know-how to future generations is a worry for nuclear data research as for many other fields in nuclear research, so the Executive Committee will make sure that the research performed within the technical work packages (WP1 to WP4) will also result in the preparation of PhD and Master theses, with the same high output as obtained in previous nuclear data projects of FP5 and FP6. In addition, a special task within WP5 will coordinate the preparation of one specific school dedicated to the nuclear data research for sustainable nuclear energy.

All final results of the projects are aimed to be widely distributed in the open literature, by the NEA to the OECD countries and by the IAEA to their members. However steps will be taken in the Consortium Agreement and by the Executive Committee to make sure that the authors intellectual property will be properly respected. In addition some intermediate results, particularly of the integral experiments, and computational tools will only be available for their use within the project. These exceptions will be clearly identified in the Consortium Agreement.

Specific aspects of the dissemination related to the different work packages are described in the following paragraphs.

In WP1, all final reports on measurements will be publicly available. Progress will be reported in workshops and conferences as appropriate and the final work will be submitted for publication in international journals (possibly after the closure of the project). Numerical results will be submitted for adoption by project participants when possible and required (WP2, WP3). Numerical results will be submitted to the international Exchange Format database via the OECD Nuclear Energy Agency.

All reports on development of covariance data will be made public as well, possibly in associated publications in international journals. In WP2, a few nuclear model codes will be developed or extended. They will be made available on local websites and/or through the NEA data bank. Resulting nuclear data libraries will also be made available to the community for testing and direct use.

The aim of the WP3 work is to exchange the process of validation on open integral experiments. In consequence the summary report on impact of new evaluations of the ANDES project of these experiment analyses will be open for common publication. The impact on nuclear data trends and accuracy on neutronics behavior will also be disseminated in open publications. The pre-existing experimental data that will be provided for this work package will also be exchanged between all the participants of the project to enforce the continuity of this work after the end of the ANDES project, however some of these data will not be made available outside the project.

All reports, experimental results and work on model development in WP4 will be submitted for publication in international journals. The experimental data, new codes and data files will be made available to the partners during the duration of the project and to the public at the end.

B 4. Ethical issues

There are no ehical issues for the project.

B 5. Consideration of gender aspects

In order to promote the participation of more women in science and decision making, the ANDES project management and project participants will:

- make sure that there is no discrimination towards female scientists at all levels of the project and encourage their participation. Some female scientists were particularly encouraged to take up a leading role as a Work package Co-ordinator and task responsible (the project includes one female Work package coordinator and several task responsible are expected) or as a member of the Governing Board;

- encourage female scientists participating in ANDES to apply for fellowships;
- support and encourage female scientists to present their work in conferences/workshops;
- encourage women to take part in activities related to knowledge management and transfer and training;
- encourage universities participating in ANDES to trigger interest of female scientists and students in the project and more generally in the nuclear data research;
- establish contacts and links with networks of women scientists in the field of the scope of the project. In particular, links will be established with the existing WIN (Women in Nuclear) network. WIN is an association of women working professionally in the fields of nuclear energy and applications of radiation. WIN was established 1993 and currently has 2500 members in 58 countries. The goal of WIN is to contribute to objectively informing the public on nuclear and radiation.

B 6. References

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